THE USE OF BLACKSMITHING TECHNIQUES IN THE CONSTRUCTION OF OUTDOOR SCULPTURE

PROBLEM IN LIEU OF THESIS

Presented to the Graduate Council of the
North Texas State University in Partial
Fulfillment of the Requirements

For the Degree of

MASTER OF FINE ARTS

By

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May, 1979

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CHAPTER I

INTRODUCTION AND STATEMENT OF THE PROBLEM

In the creation of my sculpture I have found that by designing my work to be exhibited outdoors, I am not limited to any sort of enclosed space. I am allowed greater freedom in terms of available space and in terms of the size I may choose to work. However, I have had difficulty in discovering a material that not only suited me but one that would be adaptable to outdoor display. I looked for a material that was strong, yet malleable, and a material that could be worked quickly, yet would remain unchanged once its final form was established. Steel was the material I found that had all the qualities I desired. Steel is a strong, rigid material that under the heat of a coal forge and through the use of blacksmithing techniques can be formed into an unlimited variety of shapes.

The purpose of this problem was to investigate the advantages and limitations in the use of blacksmithing techniques combined with the construction techniques of arc welding and the use of power tools to construct large outdoor sculpture. Specific questions will be asked to determine the suitability of this method of working. The questions are:

1. Can blacksmithing techniques be used in the construction of large outdoor sculpture?

a. What specific techniques are appropriate?

b. Will some techniques be used more than others?

2. Will these techniques take an inordinate amount of time and make them impractical for the artist to use?

A written journal and photographs of each work in process were used as methods of collecting and analyzing data for this study.

By this project I hope to prove that as an artist I can utilize various blacksmithing techniques and create a better, more interesting use of steel in outdoor sculpture. I believe that these techniques will allow me to work quickly and create a more personal imagery in the pieces I produce now and in the future.

List of Definitions

Bending jig: a device used as a template for bending metal. (See Figure 1, page 4.)

Hardy: a chisel with a square shank that fits into the square hole (hardy hole) of the anvil.

Horn: the beak or round pointed end of the anvil.

Nibbler: a hand-held electrical tool that shears or "nibbles" small bits of metal as a method of cutting steel or other metals.

Pritchel hole: the small round hole on the top (saddle) of the anvil.

Quench: to suddenly cool hot steel by plunging it into water, oil or other liquids.

CHAPTER II

BLACKSMITHING TECHNIQUES

Perhaps the most commonly used blacksmithing technique I found was bending. Steel when heated in the coal forge can be bent into almost any shape; the size of the steel is relatively unimportant. I used steel in various sizes from one-eighth inch in diameter to one and one-eighth inch in diameter and found that I could bend the steel into the form I desired. It is more difficult to bend the larger stock, but I found that the only limitation was my own strength. I feel that given the time to reheat the metal, the fuel, and the leverage I can bend almost any size I may choose to use. The bending of the steel itself can be accomplished in many ways. It can be bent by hammering over the edge of the anvil, by placing it in the pritchel or hardy holes and bending, by placing it in a vise, or by placing it into a bending jig. (See Figure 1, page 4.)

Flattening is another widely used technique. I used this method to accent curves, to create shapes at the ends of rods, and as a prelude to splitting, punching and drifting. By flattening the area to be split, punched or drifted I found that the tools used for these techniques have a steadier area on which to rest. Examples of flattening can be seen in Figure 2, page 5.

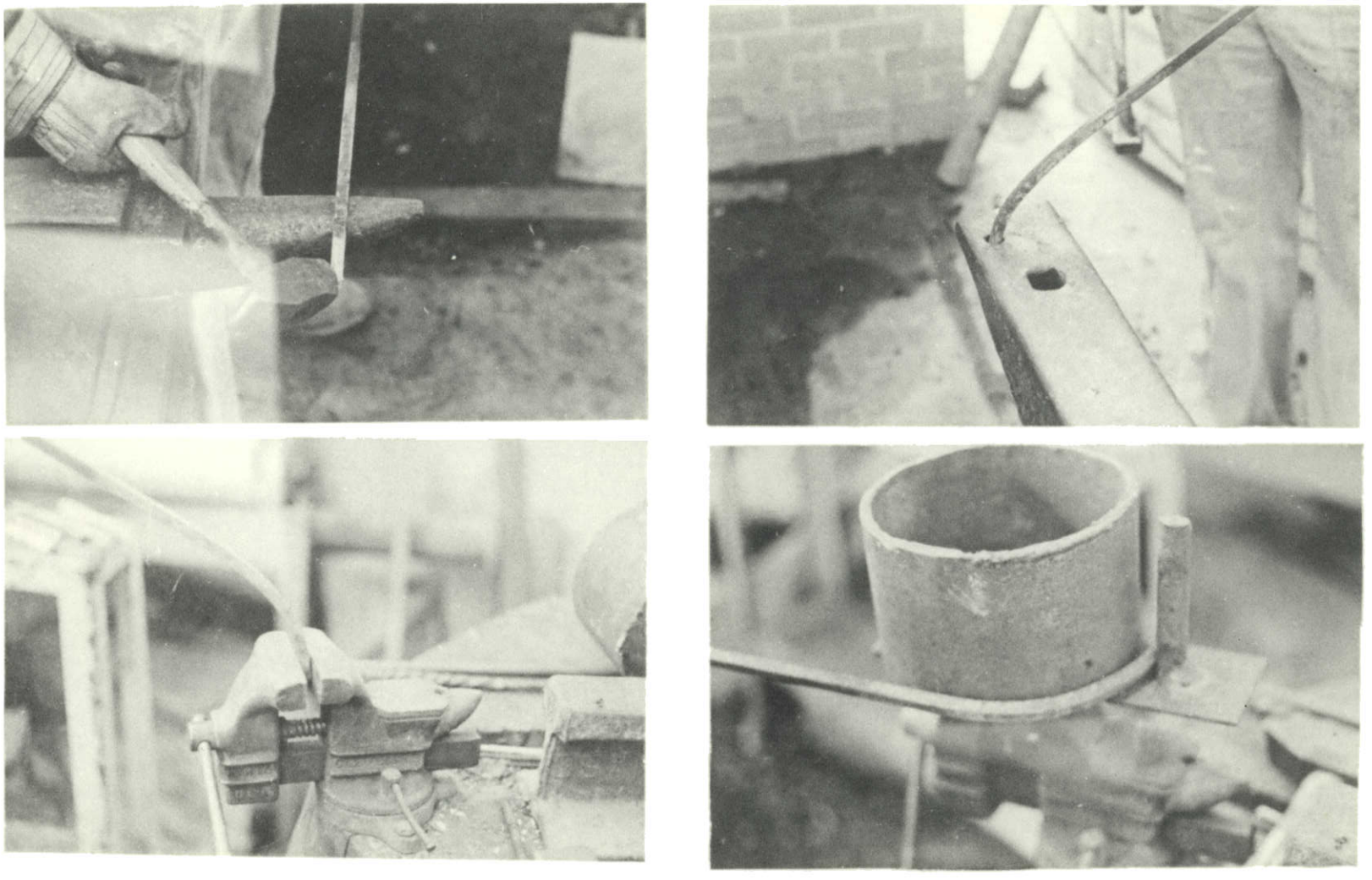


Fig. 1--Examples of bending

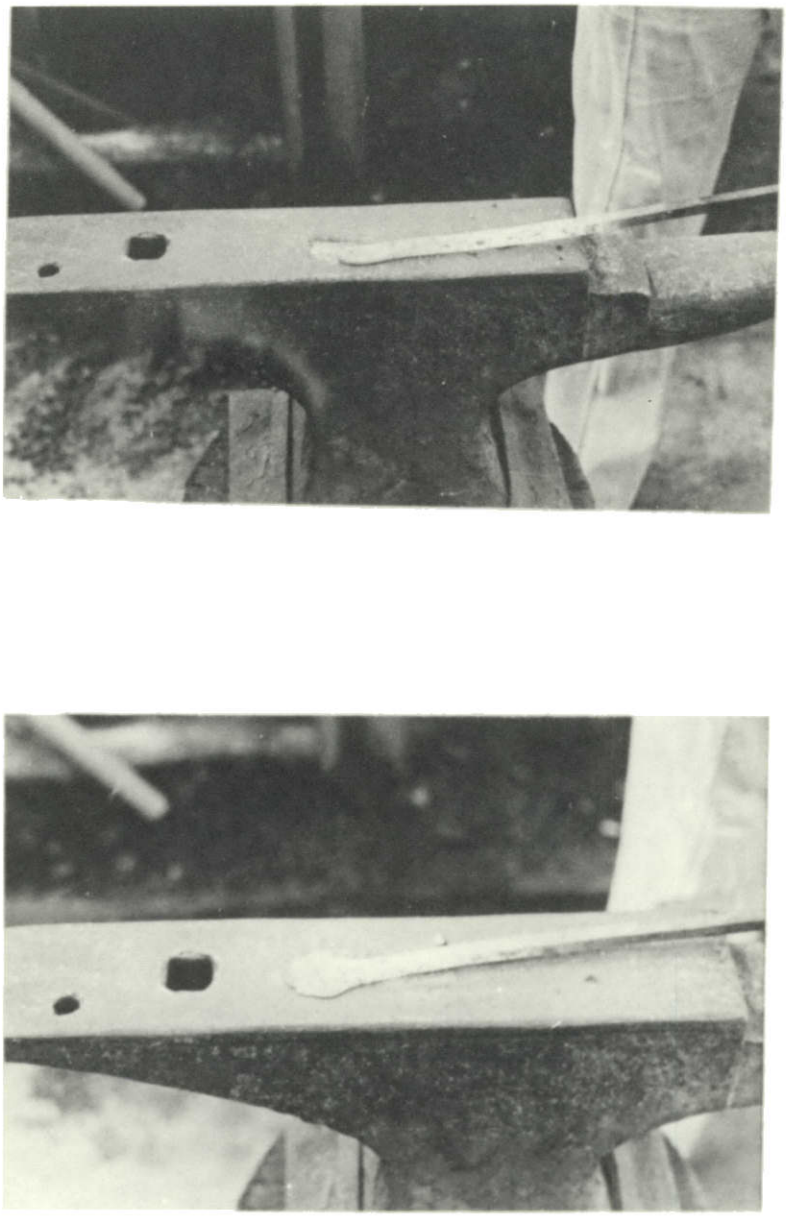


Fig. 2--Two stages of flattening

Punching and drifting are two techniques I always used together. Punching is the piercing of hot steel and drifting is the widening of the punched hole. These techniques were not used frequently and were only used as an added decorative element. These techniques were not difficult even though I had to improvise tools for their implementation. For punching I used a nail set and found it to be a suitable substitute for a blacksmith's punch. For drifting I used a drifting chisel which is a tapered, round piece of steel. It is very similar to a drifting tool except that the drifting chisel does not have a handle which made it a little difficult to use.

Punching was accomplished first by flattening the steel and then driving the punch through the steel. This was usually accomplished in one heat of the forge, but for thicker stock reheating was sometimes necessary. The punch was hammered through the steel which was placed over the pritchel hole and driven into the steel until it was pierced. (See Figure 3, page 7.) Drifting was done in the same manner by placing the drifting tool into the hole pierced by the punch and hammering the tool into the metal. (See Figure 4, page 7.) The use of a drifting tool allows one to enlarge a hole in the steel without cutting the steel by drilling. The steel is actually stretched. Another added feature of drifting is that I can make square holes by using a square drifting tool, something that is impossible to do by drilling.

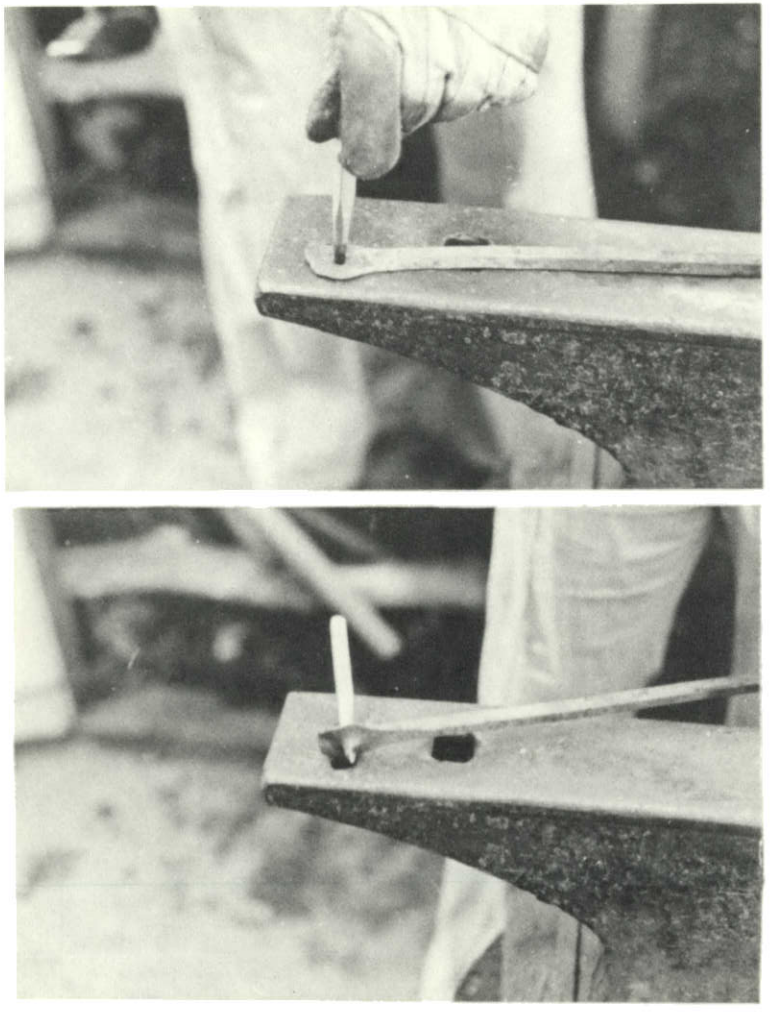


Fig. 3--Punching

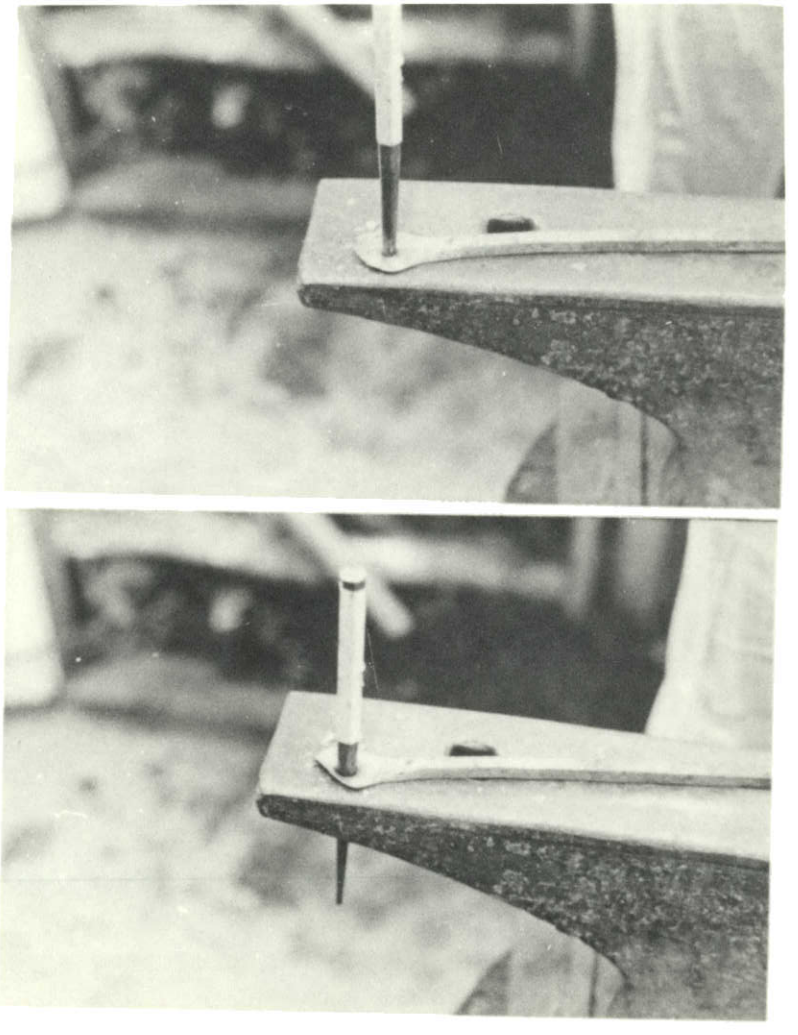


Fig. 4--Drifting

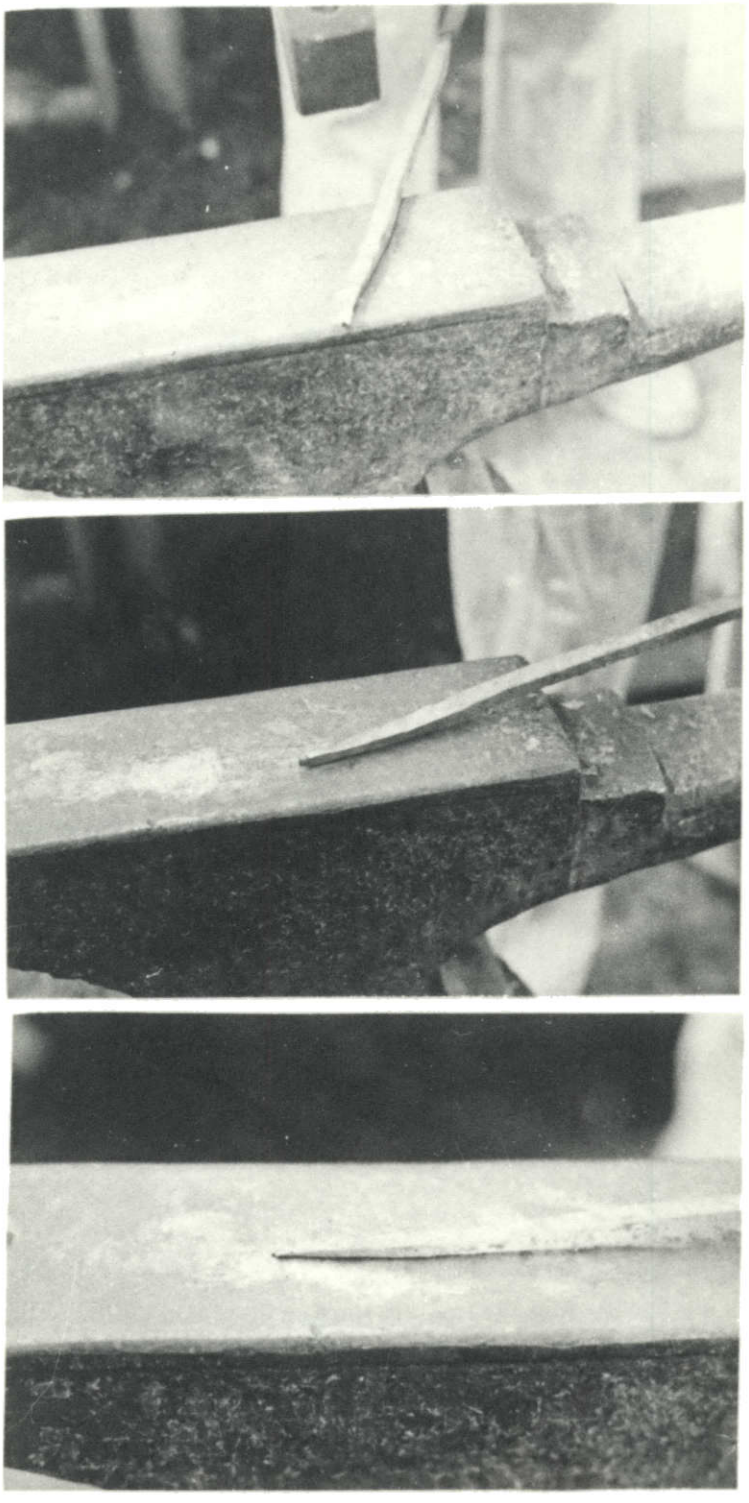
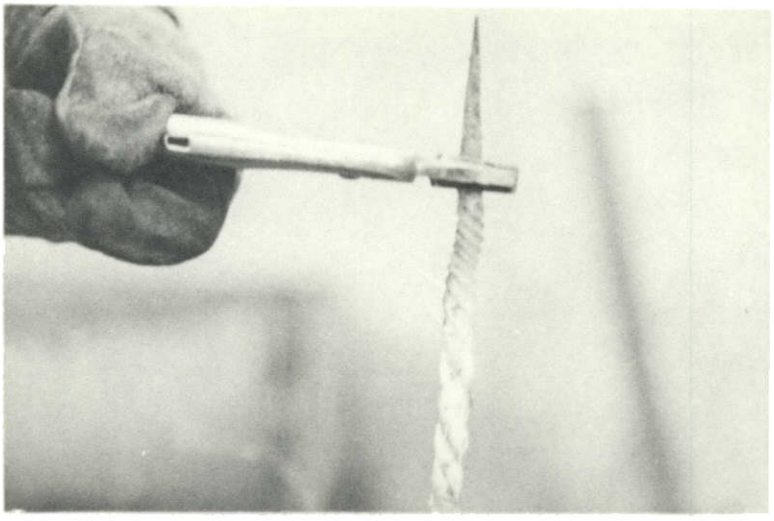


Fig. 5--Three stages of tapering

Other techniques I employed included tapering, twisting and splitting. Tapering is accomplished by a series of successive hammer blows which stretch and form the metal to a point. (See Figure 5, page 8.) Twisting is relatively simple inasmuch as the steel is clamped into a vise while hot and then the steel is twisted by using a crescent wrench, pliers, or vise grips as seen in Figure 6, page 10. Splitting is a more difficult technique. Unless the steel is of sufficient width to allow the hotset (splitting tool) to rest before splitting, the steel must first be flattened slightly. The hotset is then driven into the steel cutting it laterally in two. (See Figure 7, page 11.) Once the steel is split, the split can be widened by clamping the steel in the vise and driving the hotset into the cut or by driving the steel into the hardy. (See Figure 8, page 12.) Further widening of the split can be made by driving the cut into the side, saddle (top) of the anvil or into the horn of the anvil.

Two other techniques which I used were collaring and wrapping. Though these techniques were generally used for fastening two pieces of steel together, I used them as purely decorative techniques. I found that arc welding is a much quicker and stronger method of joining steel than collaring and wrapping. These techniques, however, added decorative elements that I found quite pleasing. Wrapping is merely the heating of a piece of steel which is then wrapped around other pieces. (See Figure 9, page 13.)



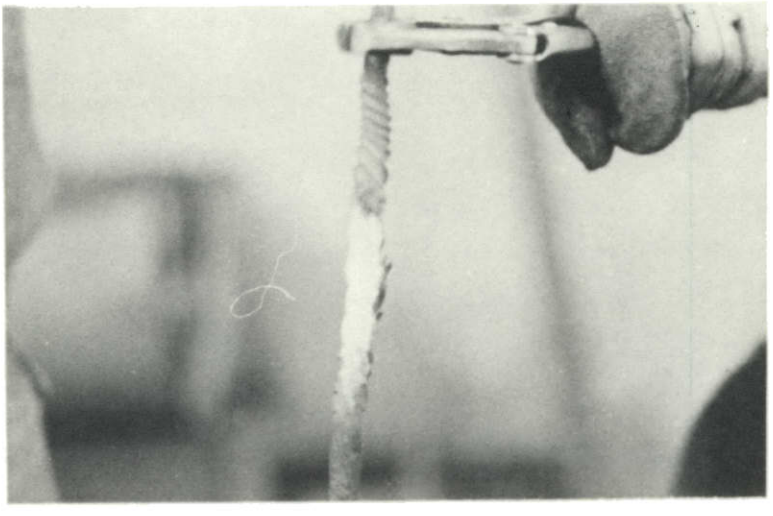


Fig. 6—Twisting

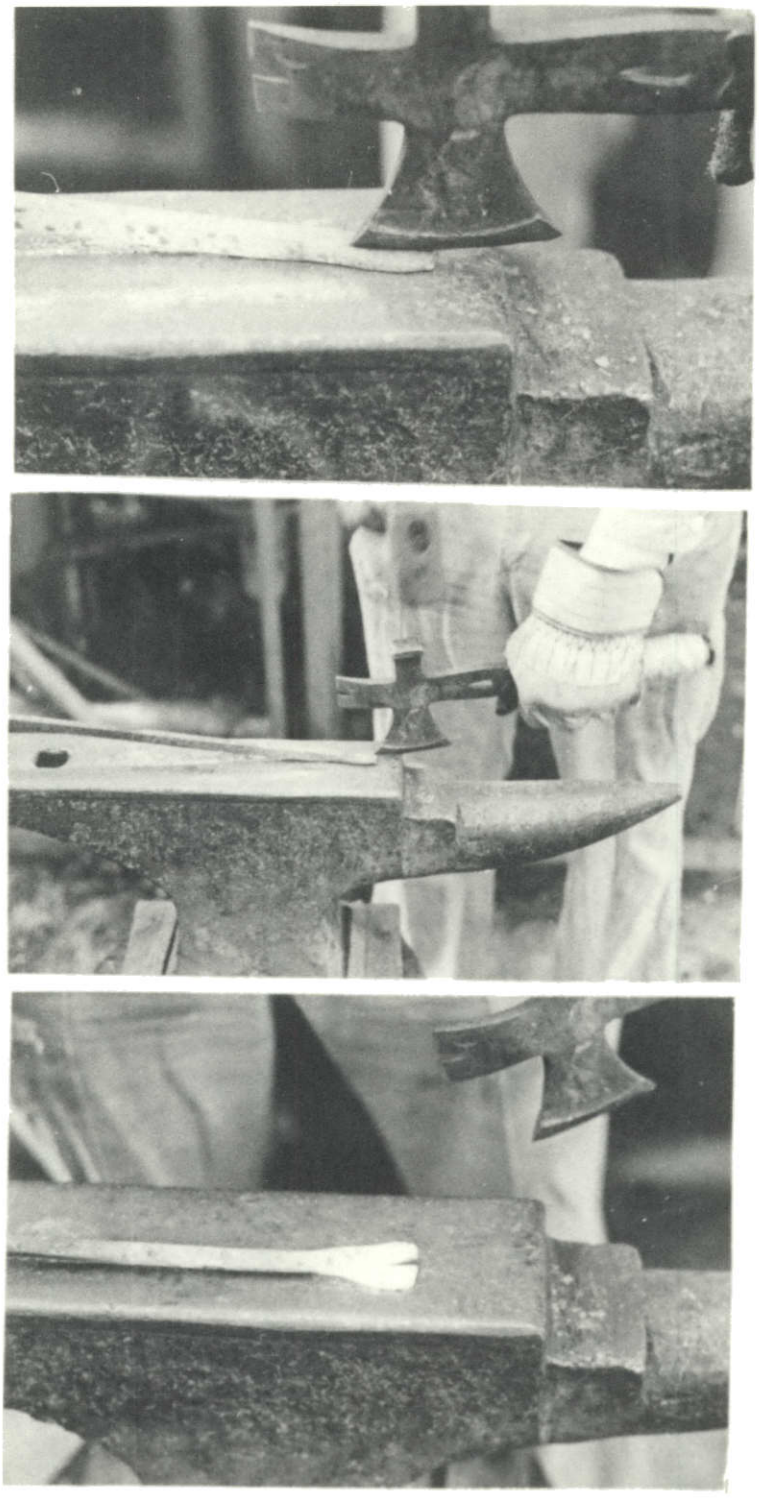


Fig. 7--Splitting

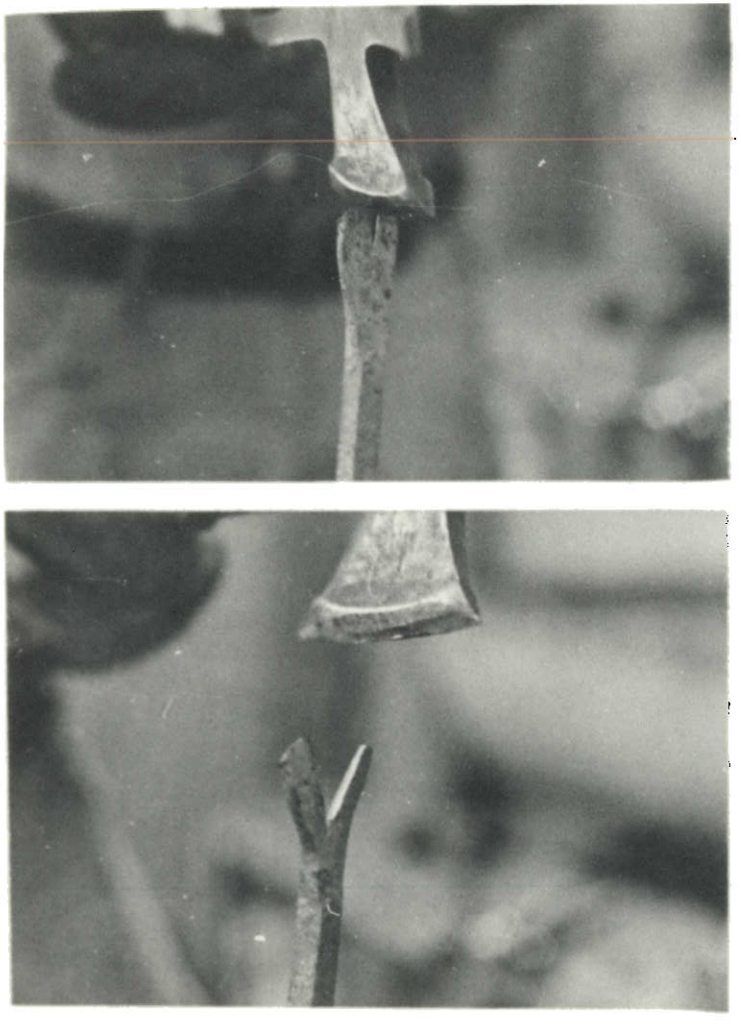


Fig. 8—Widening the split

Fig. 9--Wrapping

When this steel is quenched it shrinks and tightens around the pieces, holding them. Collaring is basically the same but it is made with only one band of steel. The band is heated and hammered around the pieces of steel to be joined. To insure a better fit I then mark the collar by hammering it onto the hardy. This leaves an indentation that makes it easy to determine where to finally cut off the collar. Afterward the collar is reheated and hammered back onto the pieces and is quenched and completed. (See Figure 10, pages 15 and 16.)

I feel that these nine techniques can be used effectively in constructing sculpture. While other techniques such as riveting and fire-welding can be accomplished much quicker by arc welding, they may later prove to be valuable as methods of working. However, I find that bending, flattening, punching and drifting, tapering, twisting, and splitting cannot be accomplished as quickly or as successfully by means other than blacksmithing techniques.

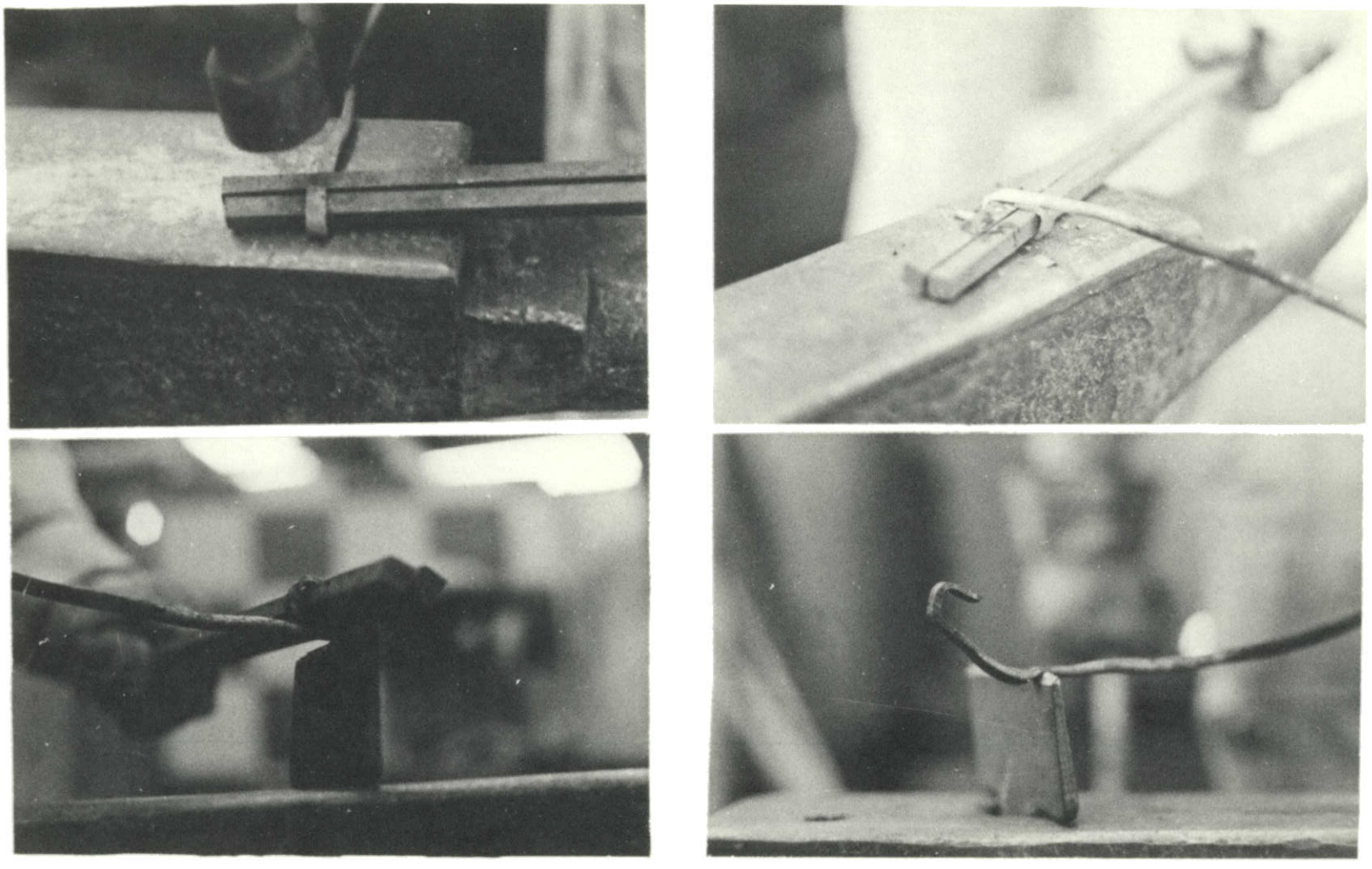


Fig. 10—Stages of collaring

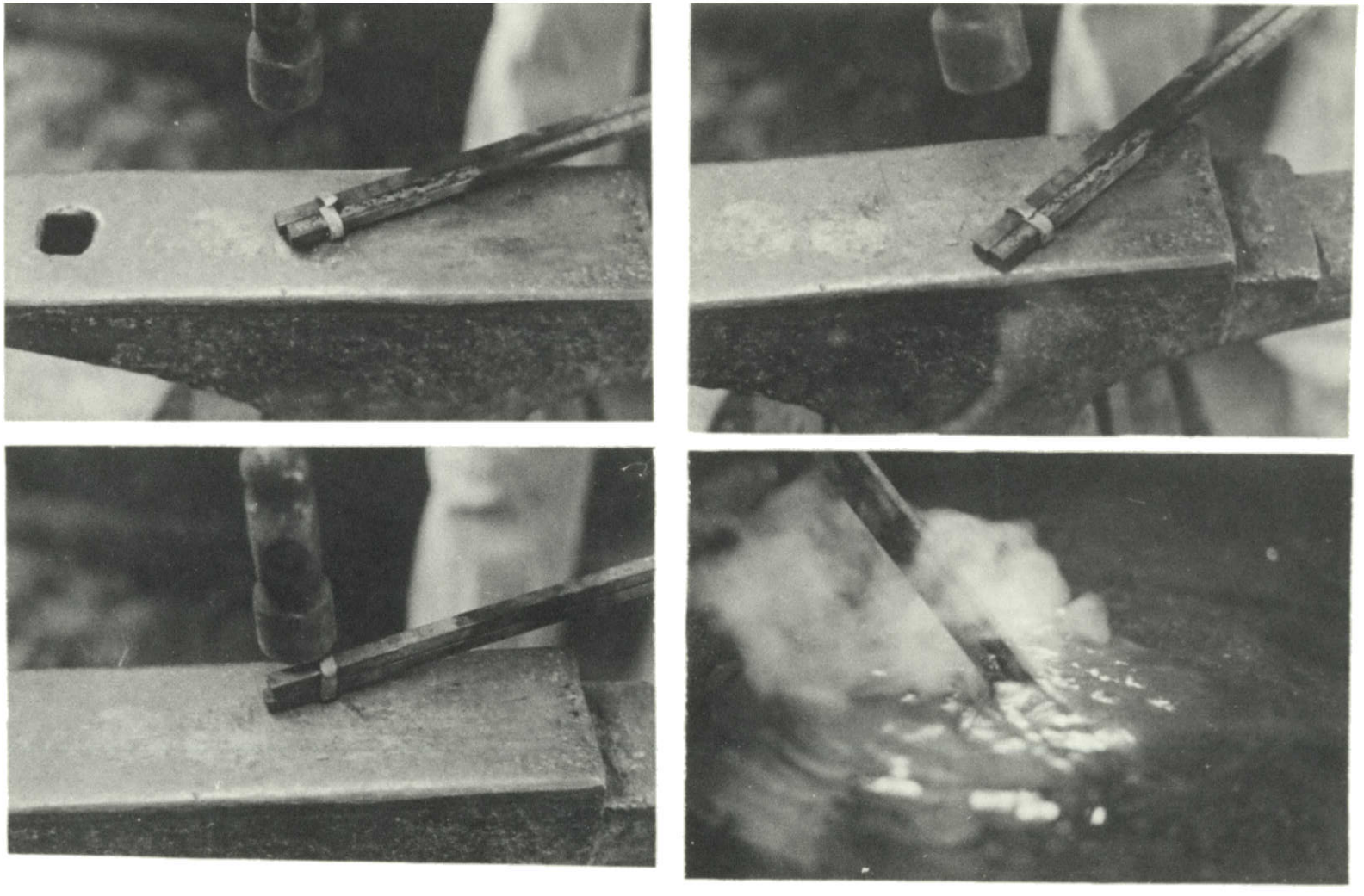


Fig. 10 (continued)—Stages of collaring

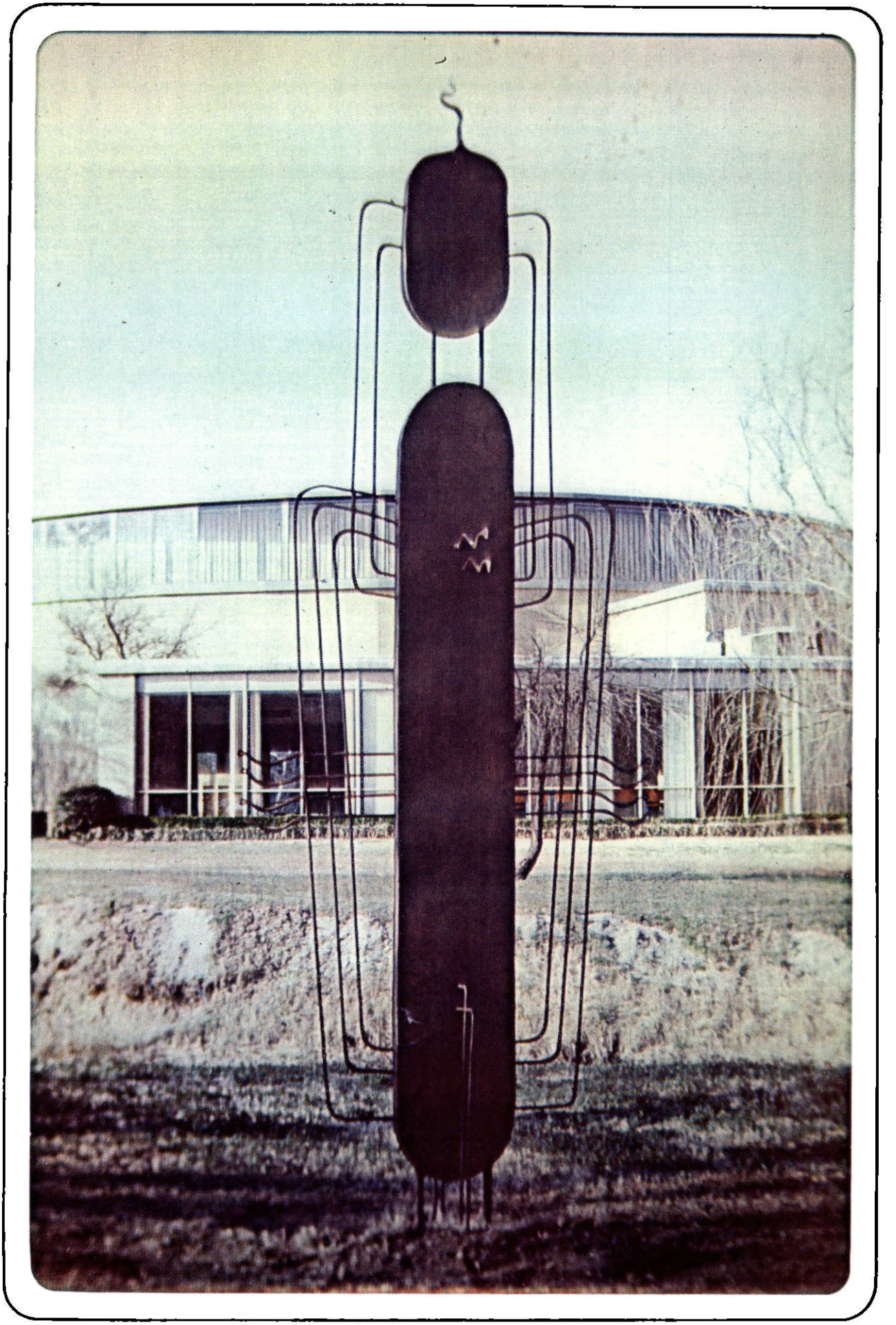


Fig. 11—Sculpture I, Standard

CHAPTER III

THE SCULPTURE

Sculpture I

Standard

I began constructing Sculpture I, later entitled Standard, with the intention of creating a piece with a minimum height of sixteen feet. This was in keeping with my original intent of using blacksmithing techniques for large outdoor sculpture. I attempted to actually construct a monumental piece without any assistance from another individual.

I began building the central closed form by first bending and shaping the upper and lower curves. These curved sections as well as the remaining framework for this central form and the upper closed form were constructed from one-quarter inch by two and three-quarter inch steel flats. These flats were selected for their thickness and relative strength and also their easy accessibility from a local scrap dealer. However, since these pieces were bought as scrap their widths varied anywhere from two and one-half inches to two and seven-eighths inches. I carefully selected pieces that closely approximated each other and began construction. I thought at the time that any slight difference in the widths of each piece could later be filled in with welding rods during the final placement of

the outside sheet steel. The gaps were indeed filled but resulted in other problems.

The curved sections were first heated in the forge and bent and hammered into a curve eighteen inches wide and twelve inches deep. I had very little difficulty in the forming of these shapes. The curves were placed on the concrete with a space of ten feet between the furthermost points. (See Figure 12, page 20.) When the curves were in this position I determined that the sides should be welded onto the curves with reinforcing braces placed and arc welded every two feet inside the structure. Additional small steel pieces were also attached as tabs for the sheet steel which was to be added later. (See Figure 13, page 20.)

I then began work on the top closed form. The shape was drawn on the concrete and the pieces measured and cut to conform to the shape. (See Figure 14, page 21.) This form was also eighteen inches wide and was designed to be three and one-half feet high. Also the very top of the form was designed to have a tapering point. This point was first cut into the general shape by means of a band saw and later tapered by forging. I found that this preliminary cutting of the taper greatly reduced the time it would have taken to taper such a thin piece of steel. After the tapering, the bottom curve of the form was forged as well as the curving shapes at the top and then all pieces were welded together. (See Figure 15, page 21.)

Fig. 12--The curves forged and laid out

Fig. 13--Framework completed

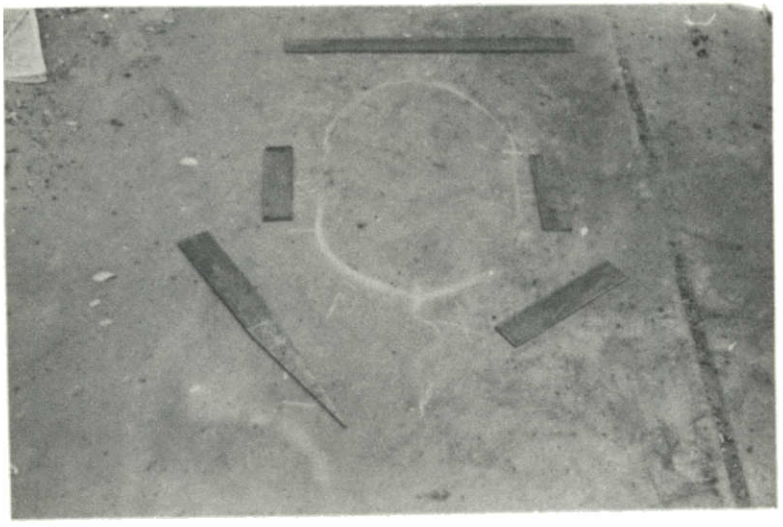


Fig. 14--Pieces cut for the top form

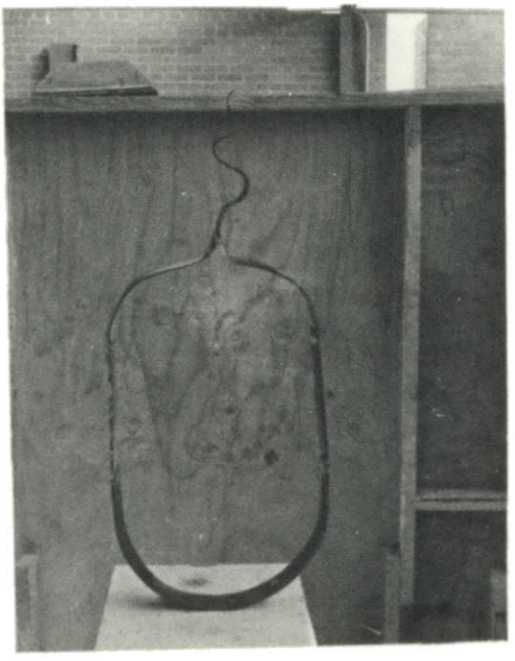


Fig. 15--Completed frame of the top form

With the framework for the closed forms completed, I then began work on the rods. The rods selected were one-half inch, solid, smooth, round steel. The first rods extend from three inches above and below the center of the top form and terminate at points two and one-half feet from the top of the lower form. (See Figure 16, page 23.) The rods were spaced from three inches at the bottom and six inches at the top. I decided to repeat a series of three inch intervals in the rods in order to duplicate the approximate width of the closed forms. This was an attempt to give the sculpture some mathematical order. After the rods were bent and placed into position I felt that they needed some additional interest. The curves of the rods were flattened to accent and draw more interest to these widened areas. I also decided to bend the rods at a more severe angle than the ninety degrees I had originally intended. I felt that this use of the rods would give the piece a greater feeling of movement. (See Figure 17, page 23.)

Because I felt that the use of the top group of rods was successful, I began work on the lower grouping of rods. These rods were bent in the same fashion by hammering them over the horn of the anvil. Again the spacing of the rods were at three inch intervals and the curves flattened. These rods extended from a point three inches above the point where the top group of rods entered into the closed form and reached a point two and one-half feet from the bottom of the form.

Fig. 16--Top group of rods forged and laid out

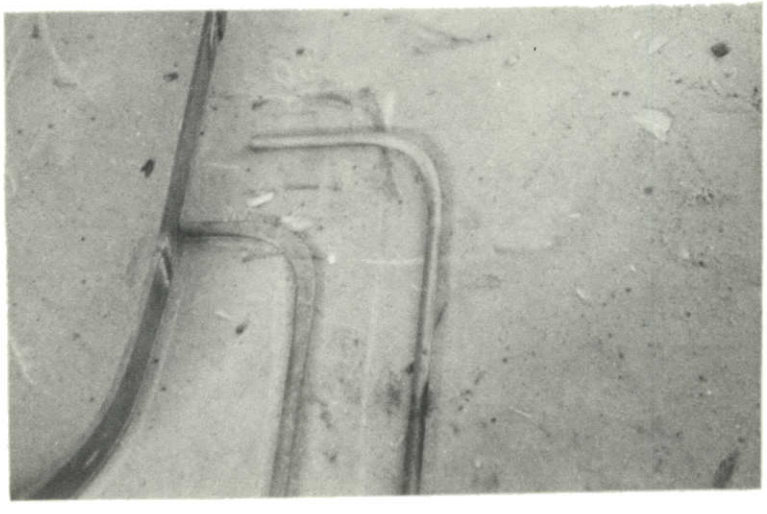


Fig. 17--Detail of rods showing flattened curves

I felt that by allowing the rods to begin at a point above the upper rods and then extending downwards this would create a very interesting intersection of the rods on each side of the closed form.

The forging of the rods was not without problems, however. The upper grouping of rods was easily accomplished but the lower grouping became awkward to manipulate. This difficulty was due to the lengths of the rods themselves; they were cut one one hundred fifteen inches, one hundred eight inches, and eighty-nine and one-half inches. This problem could have been eliminated by cutting the rods at smaller lengths and then rewelding them. I worked the rods in the later sculptures in this manner.

Since the overlapping of the groups of rods produced such an interesting grid pattern, I decided to create another pattern in the middle of the lower group of rods. These rods were to extend outward from the closed form. I decided to flatten, punch and drift the ends of these rods in order to create a decorative termination of the rods. The rods were flattened first and then a hole punched into the heated steel. The hole punched was quite small and was then widened or drifted by hammering a drifting chisel into the smaller hole while the metal was still hot. I felt that the punching and drifting were relatively successful. Similar holes could have been drilled into the steel but drilling cuts out the hole while punching and drifting actually separates and spreads

apart the metal with no loss of material. The rods were then given curves and the curves flattened to duplicate again the flattened curves of the other rods. (See Figure 18, page 26.) These rods were later cut and welded to the central closed form and the lower group of rods. (See Figure 19, page 26.)

With the rods and the framework completed I cut two rods one inch thick by eighteen inches high to be welded as legs for the entire form. Another two rods were cut one foot high to support and separate the central form from the top form. Holes were cut into the framework to attach both the legs and the rod groupings. I felt that by welding the rods inside the framework they would be supported better than if they were welded to the outside of the framework. After all these elements were welded I began to work on the sheets of steel. These sheets were of sixteen gauge steel and were cut into the appropriate shapes. The sheets, after welding, were then ground down on the edges to clean up the welding. Additional rods were added as decorative elements to the top of the central form and to the bottom of the same form and extended to a base constructed from two intersecting pieces of channel iron, four feet in length and width. (See Figure 20, page 27.)

I felt that this piece was successful. The blacksmithing produced the desired forms without difficulty. The strength of the steel allowed me to work on a large scale while at the same time it lent itself to easy manipulation. The problems

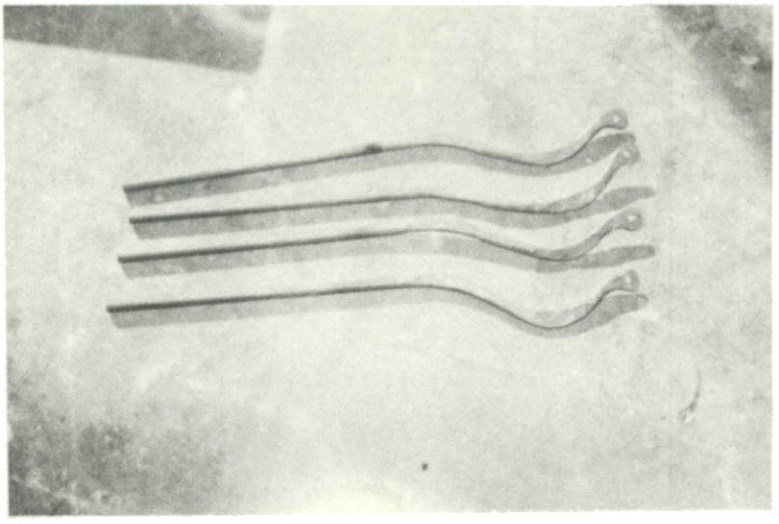


Fig. 18--Side rods punch, drifted and curved

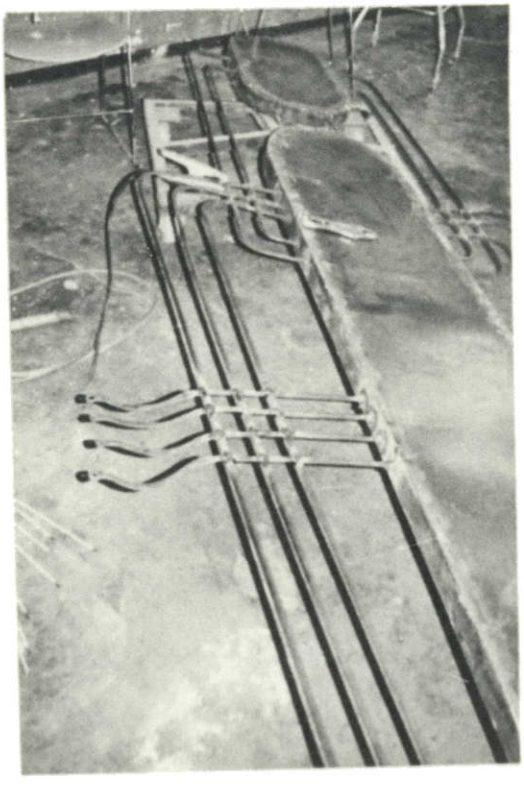
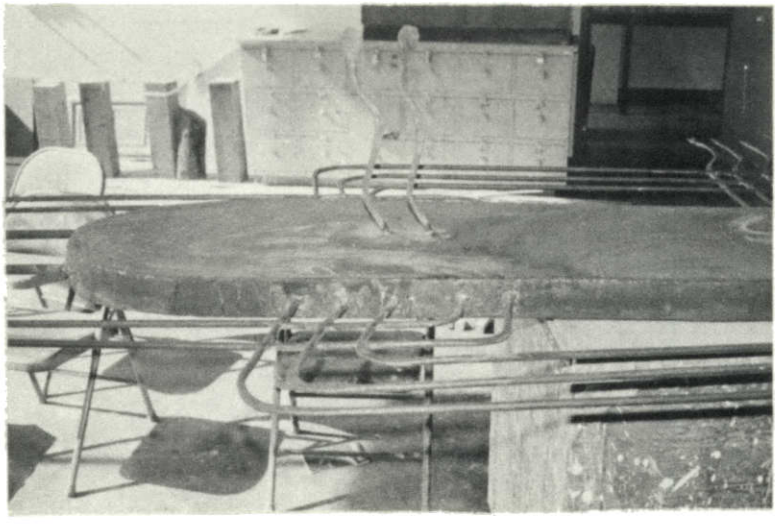


Fig. 19--Side rods welded into position



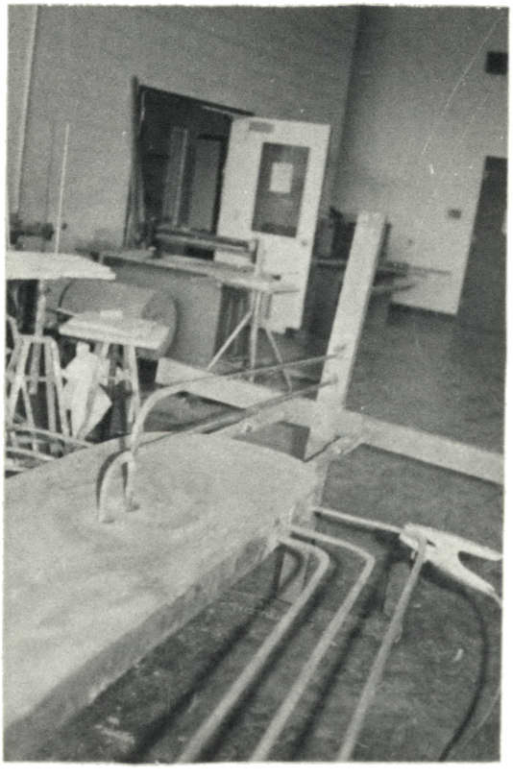


Fig. 20—Rods forged and welded to the surface of the closed form

that did arise stemmed from the fact that I used scrap steel for the framework and it was not of a uniform size. This variation caused gaps between the framework and the sheet steel that had to be filled when welding. The extra welding produced sufficient heat to warp the sheet steel and a little warpage can be seen in the framework itself. However, I feel that this warpage is not a major problem, because I feel that it gives the piece more movement with the undulation of the sheet steel. Other problems that arose concerned the space in which I worked. The size of the piece caused problems in moving the work from the forge area to the welder and back again.

Concerning the finish of the completed work, I have chosen to allow the steel to achieve a natural rusted finish. To hasten the rusting itself I wiped the steel with a six to one nitric acid and water solution, and allowed the piece to rust further by placing it outside. This rust will be coated and sealed with a clear polyurethane varnish when the desired coloration is attained from weathering.

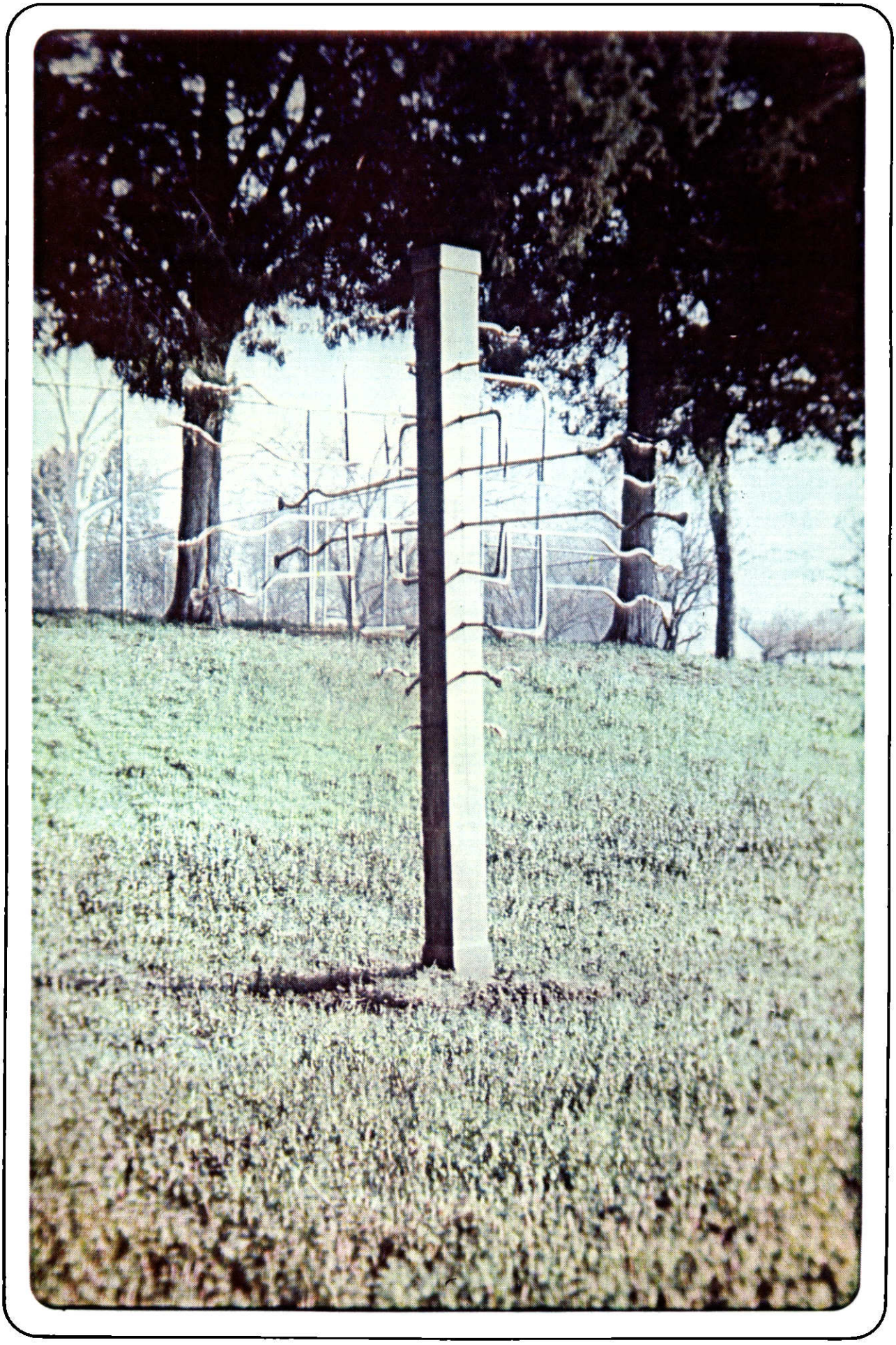


Fig. 21--Sculpture II, Cross/Double Cross

Sculpture II

Cross/Double Cross

In creating Sculpture I, Standard, I spent the majority of my time constructing the closed sheet metal forms. I spent over three weeks welding, grinding and sanding these forms. Therefore in order to alleviate what I consider an over-emphasis on the solid form, I decided to create a simplier, more quickly constructed form for Sculpture II, Cross/Double Cross. This decision was reached in order to allow more time for blacksmithing as opposed to construction techniques.

I decided to build a solid shape in the form of a rectangular column seven feet high by five and one-half inches by six inches. The material selected was the same scrap steel flats used for the framework in Sculpture I. These flats were arc welded together, two to each side of the column, and then joined at right angles to complete the column. Since these sides were welded allowing for the overlapping of the width of steel, the front and back of the column measured one-half inch wider than the sides giving the column a slightly narrower frontal view. (See Figure 22, page 32.) This was done to give the column a rectangular rather than square shape and this use of the rectangle was to be re-emphasized by the rods extending from the column.

The rods selected were one-half square stock. The longer rods were cut at forty inches thereby allowing the

total width of the rods when attached to the column to be eighty six inches or slightly longer than the total height of the column at eighty four inches. This again was to create an outside rectangular format similar to the rectangle of the column. The rods parallel to the middle sets of rod were cut at thirty seven inches or a total of six inches shorter than the total length of the longer rods. Since the rods were to be attached to the column at six inch intervals I felt that this shortening and spacing of six inches would reinforce the quasi-geometric format of this work. These sets of rods were then forged. First the ends of all rods were heated then flattened to give them an interesting area of termination. After flattening, the rods were then twisted. This twisting was accomplished by heating the rods and then placing them in the vise and with the use of vise-grips twisted until the desired number of twists were added to the lengths of the rods. The number of twists were not constant but were done arbitrarily. Since the rods were heated at the same time but twisted at different times the size of the twists vary and therefore the number of twists on each rod differ. I was concerned primarily with the length of the twisted area. Since I had already determined the approximate area where the first curve of the rods was to be established I hoped to allow the twists to run from the flattened end of the rod to the point of the first curve. (See Figure 23, page 32.)

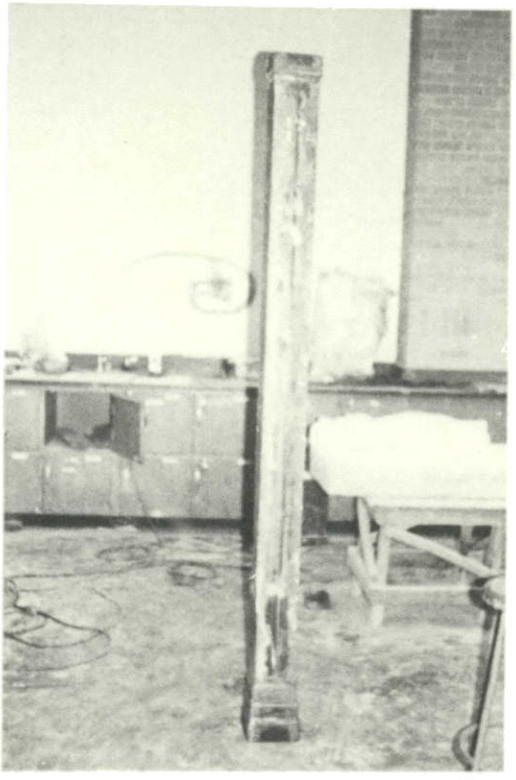


Fig. 22--Column completed

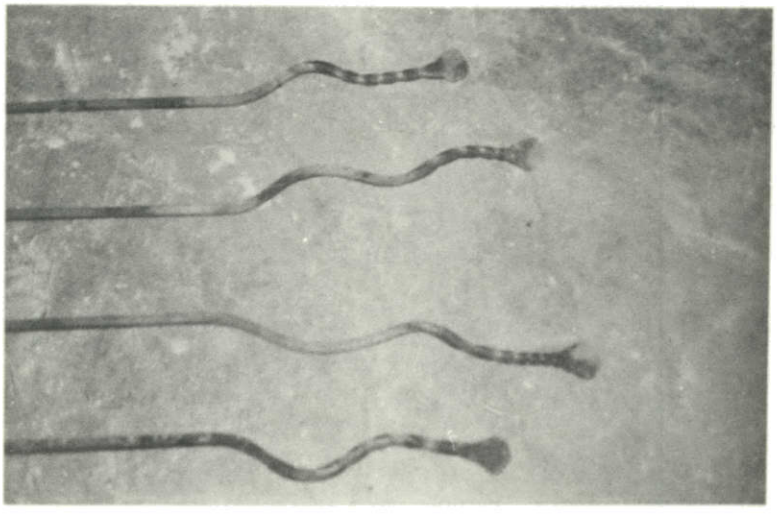


Fig. 23--Twisting, curving and flattening of the center rods

The curving of the rods was executed by heating them and then hammering them over the horn of the anvil. The rods were done one at a time, starting with the longer rods. The longer rods were bent so two curves were made. To duplicate the curves from one rod to the next, I decided to curve one rod into the shape I desired and then quench it. The successive rods were forged by using the first rod as a model. The first rod, now cold, was held along side of the heated rod and the appropriate bends were hammered into each so that they duplicated the first rod. The smaller rods were bent in a similar fashion using the larger rod as a model but duplicating only one curve of the larger rod. Figure 23 illustrates the flattening, twisting and bending of the larger and smaller sets of rods. I felt that by bending the smaller rod into one curve and the larger rod into two curves that this not only emphasized the shorter lengths but also the shape of the rods and their negative space. I felt that this framing of negative space is a very essential quality in this work.

After the center sets of rods were finished, they were laid along side the center form at six inch intervals. (See Figure 24, page 34.) I felt that the spacing and the forms created were more pleasing than had been anticipated. The next pieces to be forged were the rods that formed the rectangles that intersected the center sets of rods. These rods were cut at twelve and twenty-four inches. This length was determined so that the rods would have lengths of six inches

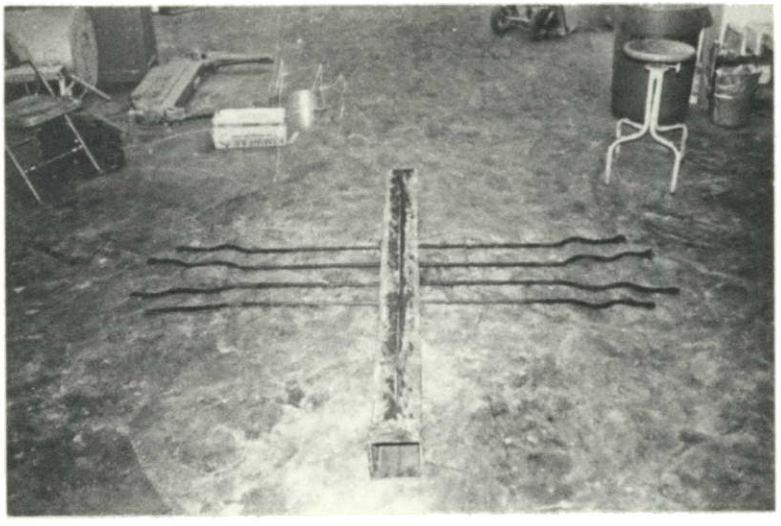


Fig. 24--Center rods laid into position

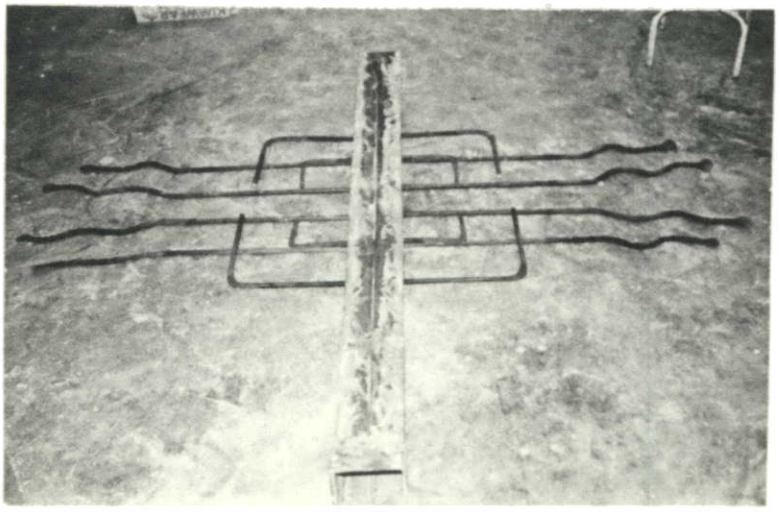


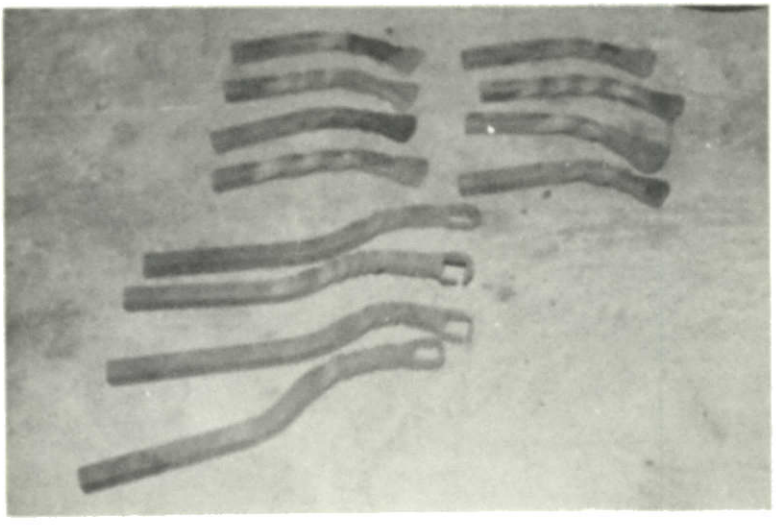
Fig. 25--Rods framing rectangles laid into position

and twelve inches when bent at a ninety degree angle. The larger rods were bent by heating the middle of the rod and then bending them in the vise. The area of the bend was then flattened to create a wider area in the shape of the rod and to accent the curvature. When finished these rods were placed into position. The smaller rectangle form was also made in an identical manner and placed into position. (See Figure 25, page 34.) The spacing between these rectangles and the rods was also six inches. Similar elements were also fashioned for the sides of the column. The elements of the sides were to duplicate the smaller rectangle and the smaller central set of parallel rods. This simpler, smaller duplication of the frontal view repeated the positive and negative forms. I felt that the use of rods in this piece created great volumes of rectangular negative space. The repetitions of the rectangle as seen in the column, the rectangular framing of the intersecting rods, the overall height and width of the piece itself, and the rectangular negative spaces which are repeated over and over again, all contribute to the visual success of the piece.

Additional elements were forged to be attached to the column at six inch intervals. These pieces were added primarily as decorative elements. Eight rods were cut at six inches and were flattened at the ends, twisted and slightly bent. Four rods were cut at twelve inches and similarly twisted. To introduce another repetition of the rectangle

the ends of these rods were punched and then drifted with a rectangular drifting tool. After the punching and drifting the rods were also bent and curved. (See Figure 26, page 37.) These elements, along with the other rods, were then arc welded to the column and to each other where any intersection occurred. The piece was completed by welding a three tiered base made of the same steel flats as those of the sides of the column. The base was welded in increasing rectangular shapes to the bottom of the column and a single rectangle was welded to the top of the finished column. This not only created a slight difference in height but added another decorative element.

By comparison to Sculpture I this second piece more nearly fulfills my initial thesis proposal of using blacksmithing techniques in the construction of large sculpture. Less time was spent in construction and a great deal more emphasis was placed on the blacksmithed forms. The column is essential to the piece but does not overpower the rods as do the solid forms in Sculpture I. I felt that the negative spaces are equally as important as the positive shapes and forms. I think that this use of negative space will be particularly effective in the outdoor environment.



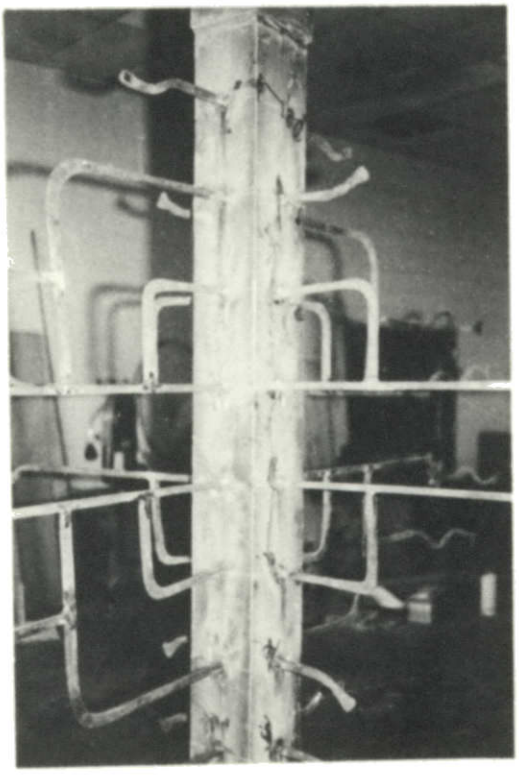


Fig. 26--Smaller rods forged, punched, drifted and welded into position

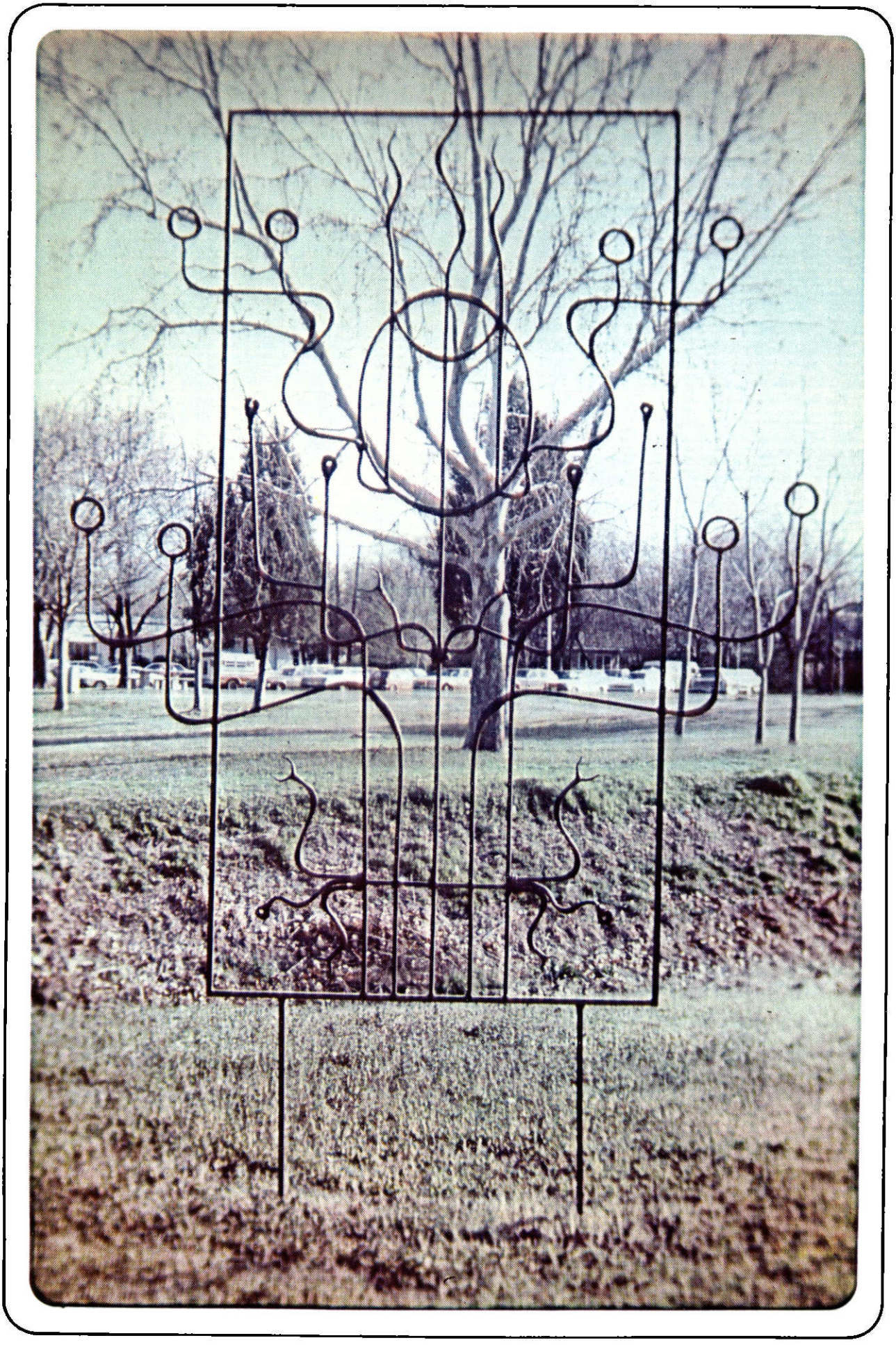


Fig. 27--Sculpture III, Architectural Screen

Sculpture III

Architectural Screen

As opposed to Sculptures I and II, Sculpture III was designed without any solid enclosed forms. This negation of the large enclosed volume was an attempt to create a sculpture that was constructed solely from blacksmited forms.

I began working on this piece by first welding one-half inch square stock into a rectangle three feet wide by six feet high. This was to form a framework for the smaller, more decorative rods that were to be blacksmithed. After the frame was completed I began drawing the design for the inside rods. My original intention was to create a screen that was based on an idea derived from a wrought iron gate; however, to alter the image of a gate into an architectural screen, I decided to pierce the frame and allow the rods to reach out beyond its confines. The drawings were made with chalk directly on the concrete floor outside the forge area. These chalk drawings can be quickly erased and redesigned if necessary. After several changes the final drawing was finished and work began. (See Figure 28, page 40.)

I decided to begin the design with the central rod. This rod, as well as all the others that are welded to the framework, is three-eighths inch smooth round steel. I selected this size because it provides a readily recognizable contrast in size and shape from the framework of one-half inch square stock. The center rod begins at the bottom of

Fig. 28--Chalk drawing of Sculpture III

Fig. 29--Center rod and top parallel rods laid into position

the frame and pierces the top. The rod is tapered and twisted beyond the point of intersection with the frame. The two rods that parallel the center rod are similarly tapered and twisted. These rods, along with the center rod, were bent and curved and placed into position in the frame. (See Figure 29, page 40.)

The rods that extend from the bottom parallel to the center rod and piercing the sides of the frame were forged next. These four rods were slightly tapered and then the ends twisted. Next they were curved in pairs. The outside rods were bent at a higher point within the frame so that they might intersect the rods closer to the center at points inside and outside the frame. I felt that this would give the rods a more interesting pattern. The curves were then flattened and the rods placed into position. (See Figure 30, page 42.)

Since I intended to create a decorative piece, I decided to add an interesting element to the bottom area that would intersect with the five parallel rods of the center. I first began by splitting and tapering two sets of rods that were to extend from the outside rods of the center. This splitting was done by the use of the hotset and was easily accomplished. (See Figure 31, page 42.) In between these two sets of rods was a single length of rod flattened and then a hole was punched and drifted through the flattened area. This rod was later to intersect the five parallel rods.

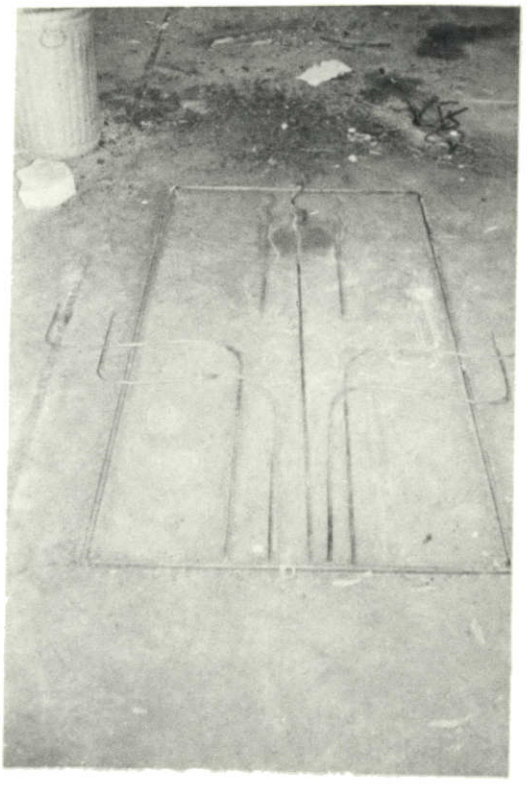


Fig. 30--Bottom parallel rods completed

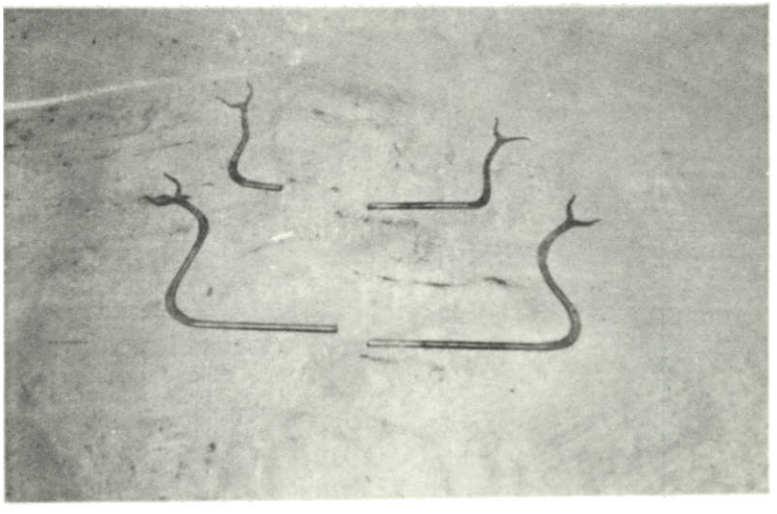


Fig. 31--Forged and split rods

To duplicate this element, four other rods were flattened, twisted, punched and drifted. (See Figure 32, page 44.) These rods remained inside the framework and intersected the four rods that paralleled the center rod and extended beyond the side of the frame.

The oval shape was then forged. This oval was to be intersected by the three tapered rods at the top of the piece. The oval was formed into its general shape first over the horn of the anvil and then over the saddle. When the basic shape was finished, the two ends of the piece were welded together and finished. The oval was then completed. This welding allowed me to secure the ends of the piece which had a tendency to widen and narrow during the forging. Once the form was completed I flattened the top and bottom of the oval and duplicated a small section of the curve that would be later placed within the oval and connected to the outside tapered rods. (See Figure 33, page 44.)

Other rods were formed that connected to the outside of the oval. Because the rods of the bottom pierced the frame I decided to allow one set of these upper rods to also pierce the frame. These rods, like the lower ones, were also slightly tapered and twisted. (See Figure 34, page 45.)

Other smaller elements were forged to reproduce the oval shape and to terminate the ends of the rods that pierced the sides of the frame. These circular shapes were made by clamping a rod onto a piece of two inch pipe and wrapping the heated

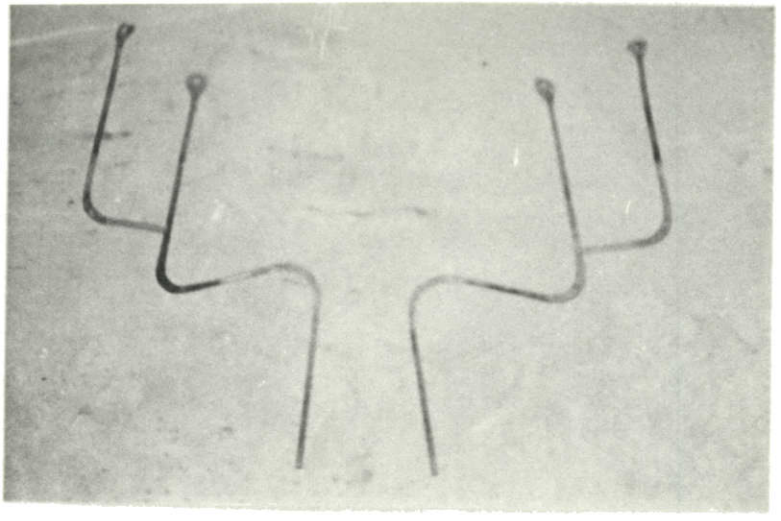


Fig. 32--Rods flattened, twisted, punched and drifted

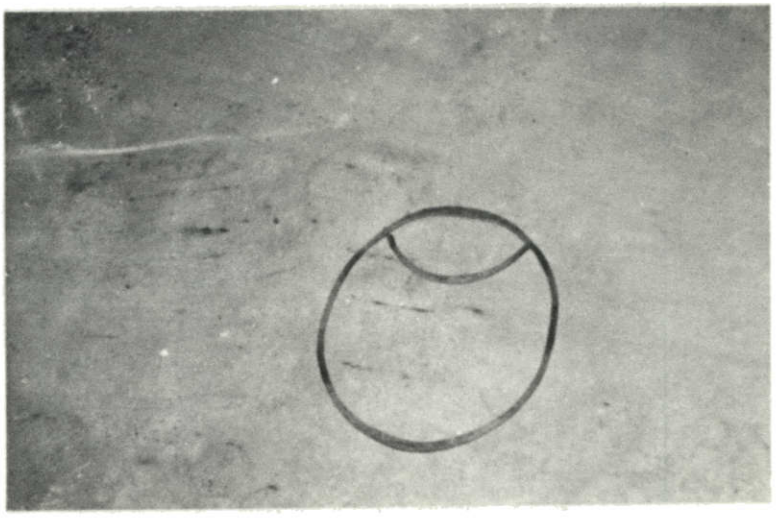


Fig. 33--Oval and curve completed

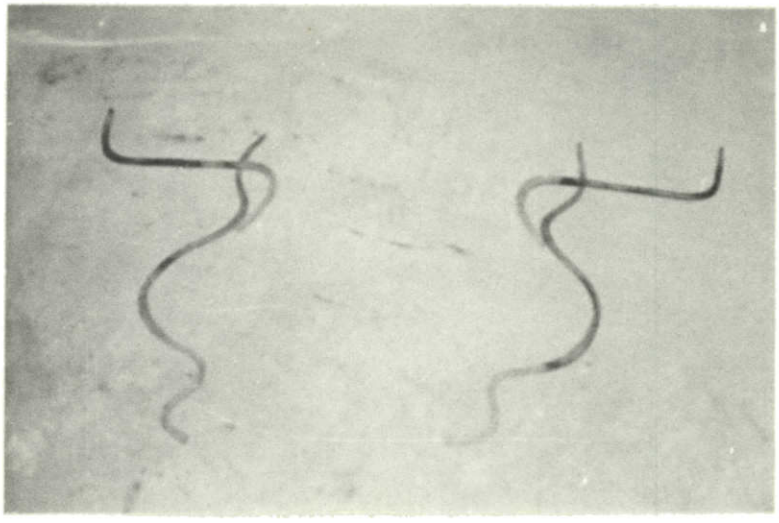


Fig. 34--Rods to be attached to the oval

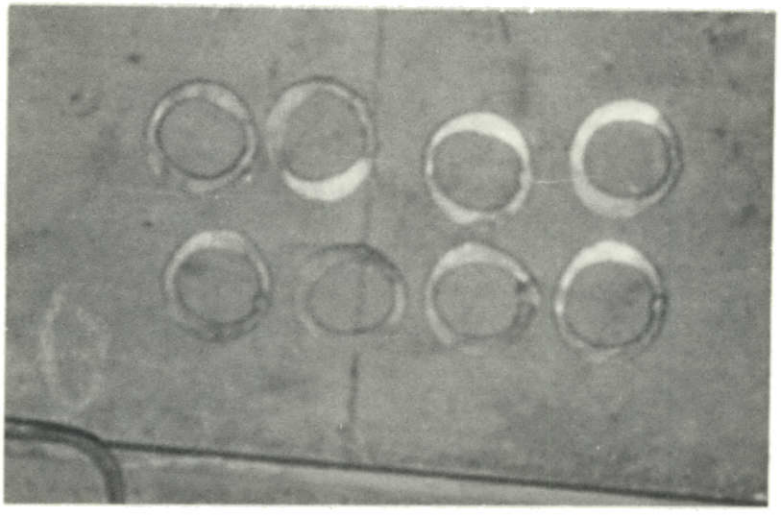


Fig. 35--Circles welded, flattened and completed

rod around it. These wrapped rods were then cut along one side and the ends were welded to form circles. These circles were then flattened. (See Figure 35, page 45.) These shapes were later welded to the appropriate rods.

Once all these elements were forged, they were cut at points of intersection with the framework and welded to it. This cutting was a little difficult because of the various angles of intersection. Also, after welding the various rods, I decided to collar or wrap areas where rods connected. This collaring and wrapping was purely a decorative addition and was done only in areas where I felt that it would create an interesting visual effect.

This piece was later provided with two legs made of one-half inch square stock that were welded to the bottom of the framework and secured in a block of cement. The cement block was designed to be buried beneath ground level and therefore became a device to support the piece outright.

I felt a great satisfaction in creating this piece. All the elements, with the exception of the frame, were beautifully forged and worked. The piece became an object not only to be viewed but a frame for the outdoor space it occupies. The rods, like the rods in Sculpture II, not only occupied positive space but also enclosed negative space and that became almost as interesting as the rods themselves. I enjoy the sense of lightness and movement in the piece as well as the spontaneity of creating such a work of sculpture.

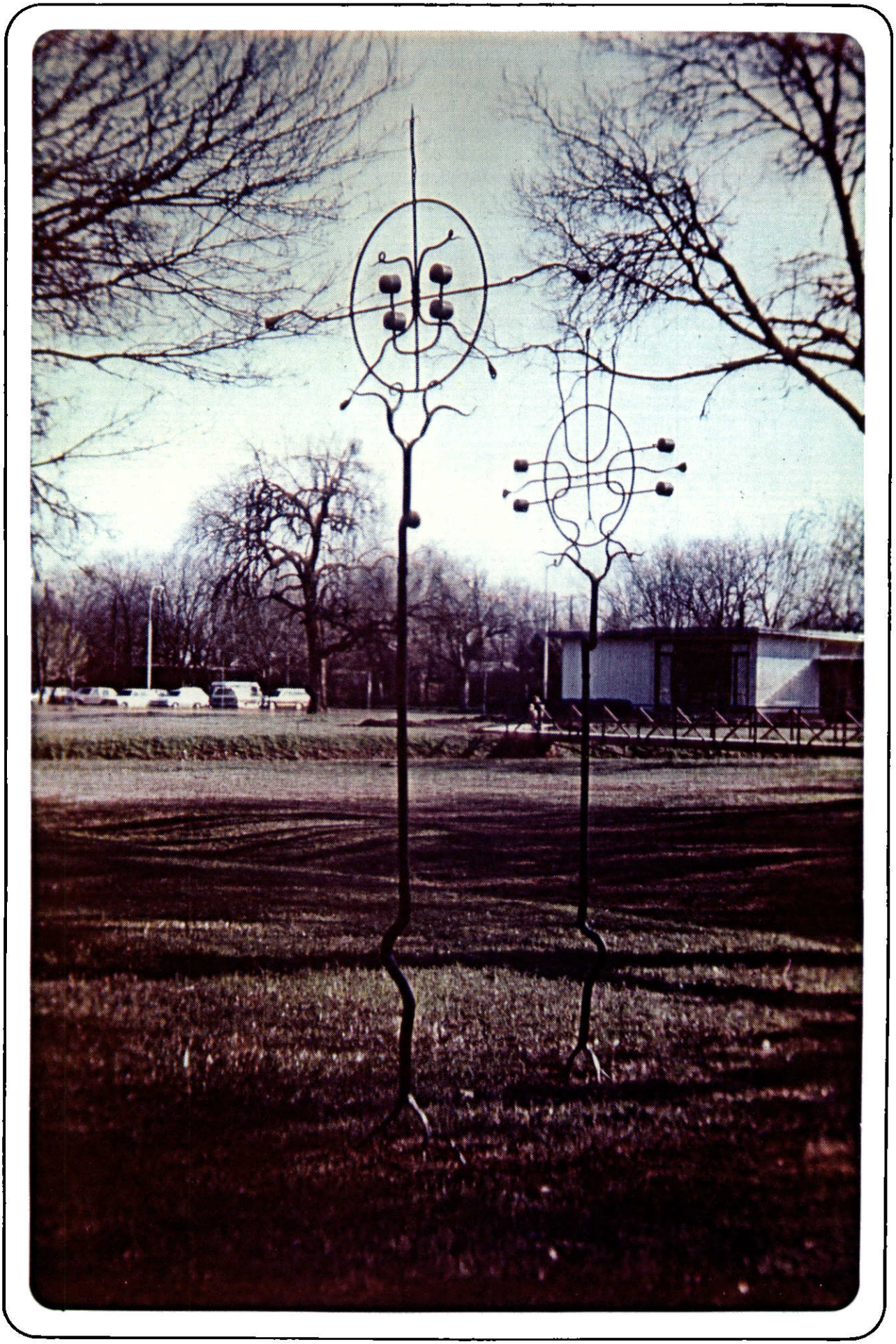


Fig. 36--Sculpture IV, Standards for the Sun and Moon

Sculpture IV

Standards for the Sun and Moon

Sculpture III was very fulfilling not only in its creation but also in its completed form. Therefore for this last sculpture, I intended to continue working more with blacksmithing techniques instead of general construction techniques.

In this final piece I had hoped to create in steel a more personal imagery. While I felt that all the work prior to this piece could be considered my own personal rendition of various influences, I wanted this work to reflect my total sphere of influence. To clarify this point I could see in my work the influence of Art Nouveau in the Architectural Screen, the influence of early Christian Art in Cross/Double Cross and the influence of the Romanesque standard in my first piece, Standard. However, in this final work I wanted all possible influences to merge together in one piece.

I began working on this piece with the intention of creating two standards, standards that would not be symbols to any past generation such as the first piece in this project, but standards to more universal images, the sun and moon. Yet the objects that were to hold the circular images were to be created as an essential part of the piece and not merely as bases. By using a variety of blacksmithing techniques on these stands, I was able to tie in the symbols and make the bases symbolic.

Work was begun on the stands. I chose to use one and one-eighth inch solid round stock because of its physical and visual strength. I began by forging the bottom of these stands. The bottoms were split six inches and these halves were again split three inches each. This splitting was to give the piece four legs for stability. The first halves were tapered and squared to produce an interesting transition from the solid roundness of the one and one-eighth inch stock to the now squared split halves. This transition was also repeated from the first halves to the three inch splits. These small sections were spread apart and forged square. They were then tapered and twisted and the ends flattened to give the work a greater area upon which to rest. The splitting, tapering and flattening did take more time than expected, but, considering the effect, I felt that the time was well spent. After the legs were finished, the upper portion of the rod was bent and formed. I wanted the steel in this piece to have a feeling of movement, of rising from the earth and the curves in this section could only increase that sense of motion. (See Figure 37, page 50.) After these pieces were curved into the desired forms I felt that they were completed.

The top sections of the stands were the next pieces to be forged. These sections were also split into six inch halves and then the halves split three inches. The six inch splits were tapered, squared and then twisted. These twists I felt gave the work a greater sense of movement and were repeated

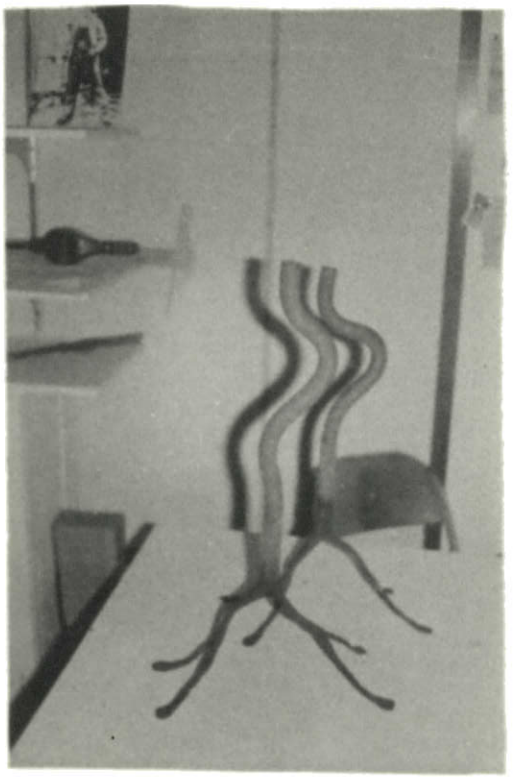


Fig. 37--Bottoms of the stands

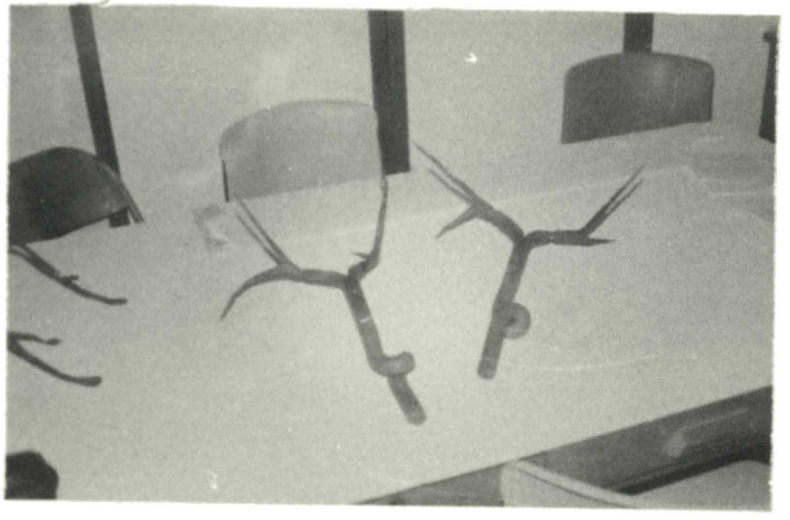


Fig. 38--Tops of the stands

in the three inch, split sections. These three inch sections were tapered to small points and then twisted radically. This gave these sections from the beginning of the six inch splits to the end of the three inch split an ever increasing number of twists from the larger stock to the smaller terminating points. After these sections were completed, the remainder of the rod was bent and formed into a complete curl. (See Figure 38, page 50.) This top section and the bottom were to be joined by sections of pipe which had an outside diameter of one inch.

The top circles were then begun. The circle itself was made of three-eighths inch round steel that was bent around a circular bending jig with a diameter of eighteen inches. I used this jig to insure that both circles would measure the same and to facilitate the completion of almost perfect circles. To repeat the image of the circle I decided to include in each piece four circles that were cut from a section of two inch pipe. Each piece of pipe was cut at a length of one and one-half inches. These pieces were laid out in their approximate positions. (See Figure 39, page 53.) The next section formed was the rods for the design of the sun image. The rods in this piece were also three-eighths inch round rods. I began by tapering and flattening opposite ends of the rods. Before flattening the bottom ends, I tapered a small section of rod so that the rod goes from a larger to a thinner area before being flattened to a still larger area.

The top of the rod was also twisted in the tapered area and bent into a circular shape approximately one and a half inches from the end. (See Figure 40, page 53.) The rod was curved into an easily flowing design and the curves were flattened slightly.

The next rods were the intersecting vertical and horizontal lines. The vertical rod extends from the bottom of the circle and pierces the top. The top of this rod was split into three pieces and the center pieces were twisted with the two outside pieces curled back. (See Figure 41, page 54.) The horizontal rod was flattened at the ends and tapered and twisted just before the flattened areas to duplicate the same treatment of the other rods that extend past the sun circle. (See Figure 42, page 54.) The last rod in this piece to be forged was the curve that holds the inside covered circles. This piece was done in one single length of rod that was curved. The curve was flattened and the rod cut in two. All these rods were cut into sections where they intersected other rods and were then welded to the circle. The sections of pipe were later covered with circles of sheet metal and welded to give this piece and the other circle some solid areas of interest.

The last piece constructed was the moon circle. I first forged the center rod by splitting the bottom and then tapered the ends of the split section. The rod was also slightly tapered before the area of the split and this tapered area

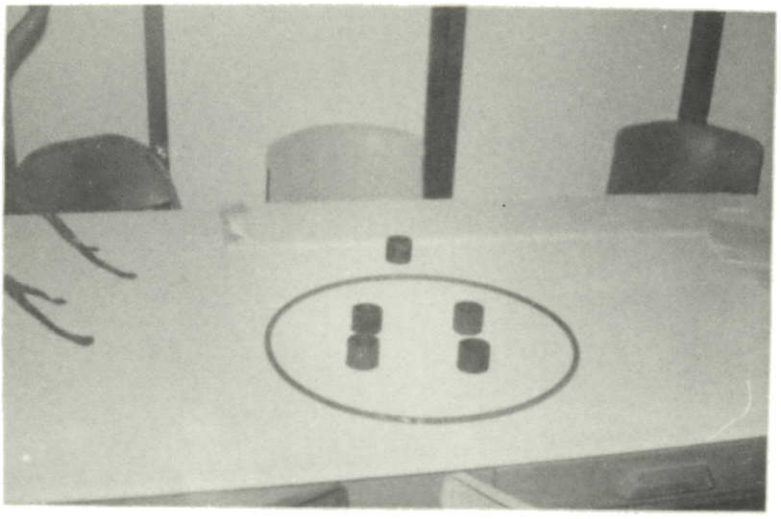


Fig. 39--Sun circle with pipe sections

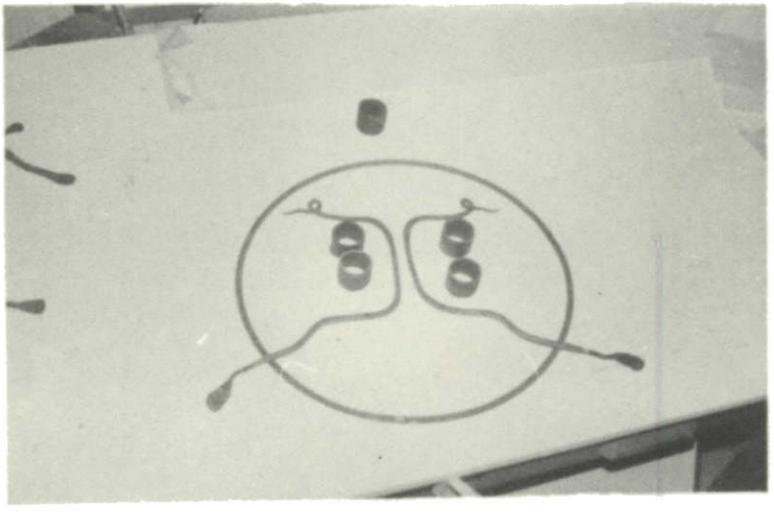


Fig. 40--Rods tapered, flattened, twisted and curved

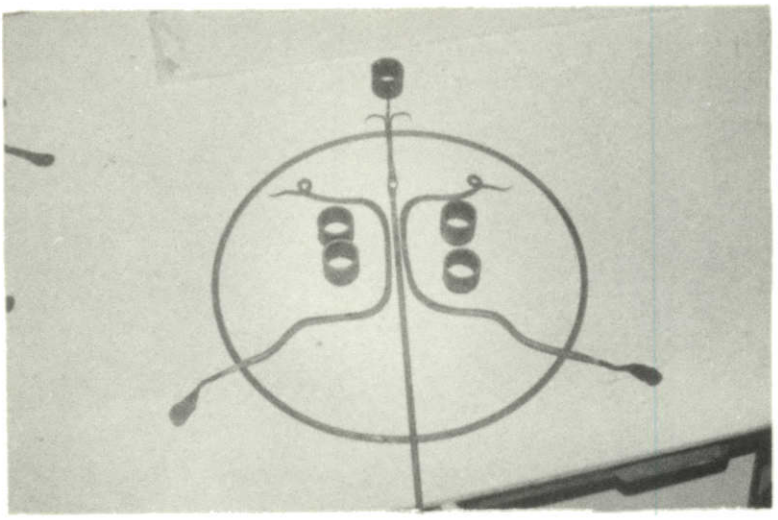


Fig. 41--Vertical rod split and placed into position

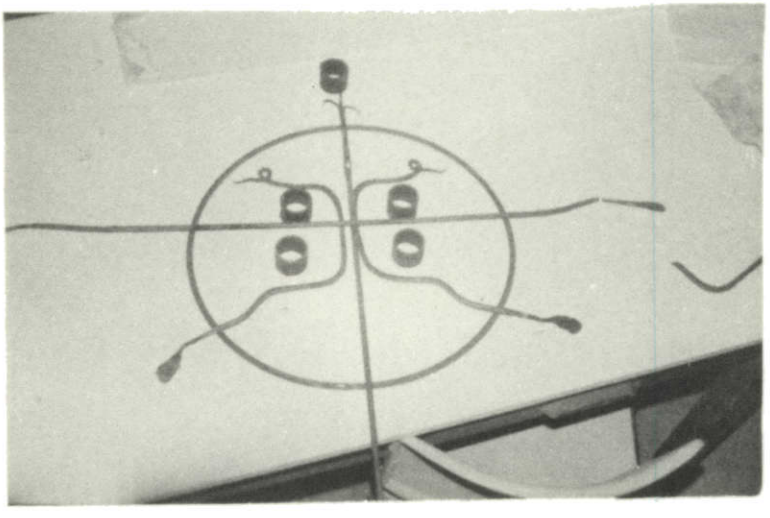


Fig. 42--Horizontal rod flattened, twisted and placed into position

was twisted. The top end of the rod was first flattened and then a hole was punched and drifted to the desired size. This rod was then placed into the circle. (See Figure 43, page 56.) Next to be forged were the rods that intersected the center rod. The lower rods were tapered on the ends and twisted. This twisted area was formed into a circle to duplicate the similar treatment of the rods of the sun circle. (See Figure 44, page 56.) The top curve was then forged by tapering the ends and then bending the curves and flattening them. These were also placed into position. (See Figure 45, page 57.) Additional elements were also curved to simulate the top curve. These curves extend out the sides of the circle and terminate in the pipe circles. Like the top curved section, they were also flattened.

After the completion of the two circles, the stands were then welded and the circles placed on the top of the stand and welded into their final positions. These pieces were finally coated with stove black, a commercially available product that closely resembles a traditional oil finish. Additional decorative wrapping was added onto the straighter section of the stands. This was added to break up the monotony of the straight pipe after welding it to the upper and lower sections of the stands.

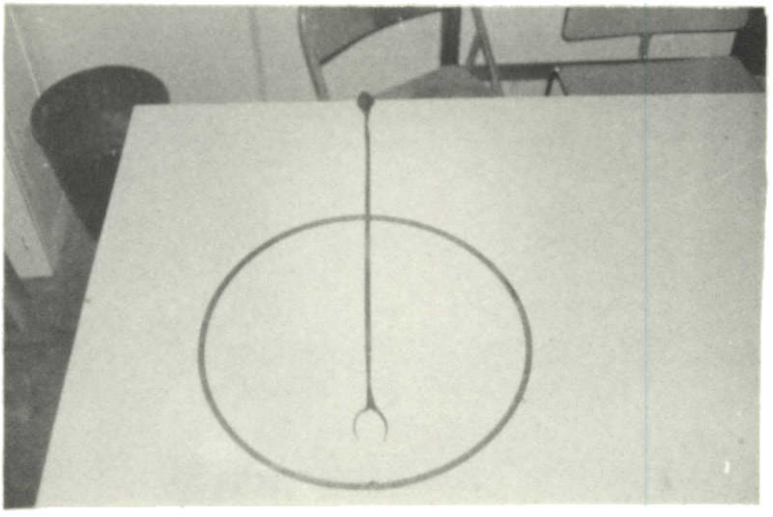


Fig. 43--Moon circle with vertical rod flattened, split, punched and drifted

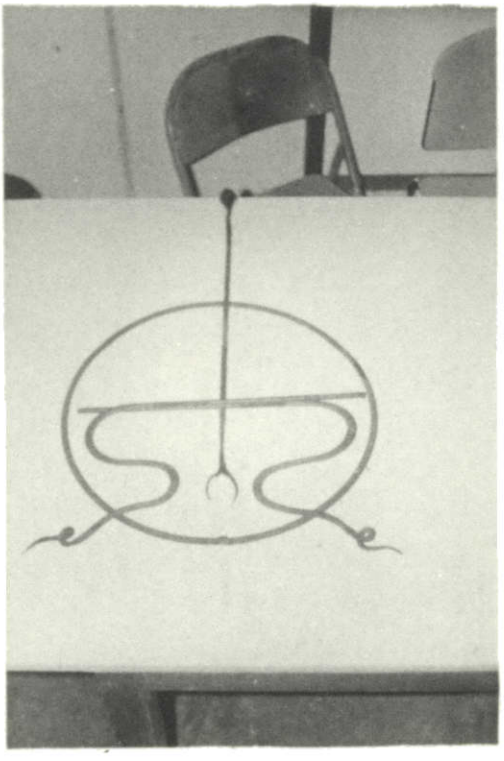


Fig. 44--Intersecting rods tapered, twisted, and curved

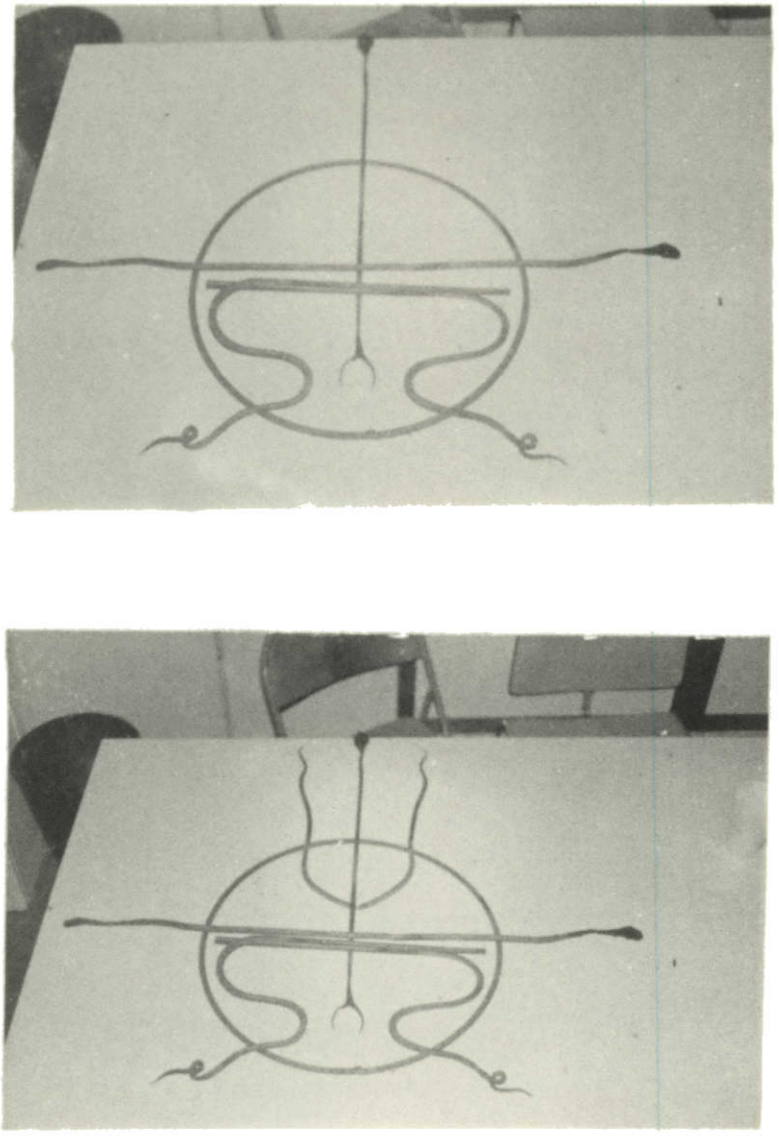


Fig. 45--Horizontal rod forged and laid in position with top curve tapered and forged

CHAPTER IV

EVALUATIONS AND CONCLUSIONS

I felt from the very beginning that the blacksmithing techniques of bending, flattening, tapering, twisting, splitting, punching, drifting, wrapping and collaring could be used in the construction of outdoor sculpture. Each technique was proven to be a quick, easy method of forming steel. I have found that size and scale are no barrier to the employment of these techniques. I have worked on pieces that reach a height of sixteen feet and have forged details that measure less than one-sixteenth of an inch. From monumental to minute these techniques work and work well. In my opinion these techniques are perhaps the most perfect method of using steel for sculpture.

Every technique used in each piece of sculpture proved essential. Whether the technique was part of the overall construction as in the bent curves of the framework of Sculpture I or in the decorative detailing such as the wrapping in Sculpture IV, each proved to be an important method of working steel.

Each work of sculpture is successful in its own way. Sculpture I, for example, demonstrates that steel and blacksmithing techniques can be used in a piece of sixteen feet high. The bending of the steel in this piece is used not

only in terms of decorative addition, as seen in the rods that attach to the sides of the sculpture, but also as an integral part of the construction, as evidenced in the curved sections of the framework. Each technique lends itself to this work. This sculpture stands strong, powerful; it not only reaches skyward but also outward. The rods that curve inward toward the piece and reach outward at the sides give the piece movement up and down and side to side. The rods become more than mere decoration. They become an equal part of the total work. I feel that the center form appeared too large and solid, at first, but by curving the rods at a more severe angle than ninety degrees and by flattening and widening these curves more interest was drawn away from the enclosed form and to the sides of the piece. Other areas of interest were added and other techniques proved valuable. For example, the rods that reach from the middle of the center form were flattened and then punched and drifted. This little detail, I feel, added a lot to the otherwise uninteresting ends of the rods. These techniques along with the tapering of the top form proved to be a fast method of working the steel into interesting and varied shapes. I feel that the only detriment to this work was the time spent in construction. However, for a piece this large and for a piece that was built by only one person, I do feel that the time was well spent. This piece becomes a symbol, a standard, not only in its

reference to a historical past, but also to my achievement in creating this work.

Sculpture II allowed me to get away from the lengthy time spent in construction and to work more in terms of blacksmithed forms. To me the most successful aspect of this piece was the fact that it too created large areas of volume, as did Sculpture I, but all this volume was in terms of negative rather than positive space. The rods that reached from the column created interest not only in their own forms but also the shapes they enclosed. The blacksmithing techniques allowed me to create strong, geometric shapes that, like the rod, branched out into curving organic forms. The techniques also allowed me to continue this type of organic movement in the twisted ends of the rods and the flattening created other forms that might be seen as organic shapes also. In this piece I like the repetition of the multiple rectangles from the column, the outside dimensions of the rods, the inside framing of the rectangles, and the small punched and drifted rectangular ends of the smaller rods. Every aspect of this piece was produced as intended using the blacksmithing techniques.

In Scuplture III, I intended to produce an object that was more decorative than I had ever created before. My imagery was greatly influenced by Art Nouveau ironwork, but I wanted to make a gate-like screen that was based on this type of imagery but interpreted into simpler, more personal terms.

One simple way to abstract this Art Nouveau influence was to design this piece as a symmetrical, instead of asymmetrical, configuration. Another interpretive technique was the piercing of the framework that changed an otherwise functional gate form into an architectural screen. I intended this screen's function to be one of gracing the outdoor environment, to be seen and also seen through. The majority of techniques in this work were designed to decorate and enhance this piece. They became integral parts of this piece only because of the highly decorative quality of the work. Each detail only helped to add interest. I intended not only to frame space as I did in Sculpture II but also to break up shape with the introduction of details such as the split forms at the bottoms and middle of the screen. In this piece I enjoyed the simplicity of design, the subtle detailing of the twists, the width of the flattened areas in opposition to the thinness of the tapered ends, and the parallel spacing of the rods at the bottom in contrast to the intersection of rods throughout the piece. I feel that this work has a great deal of movement built into it, from the center rod that rises the length of the screen and pierces the top of the frame to the rods that start at the bottom and curve gently to pierce the sides. I believe that this piece will be particularly suited to an outdoor environment with its direct reference to organic form.

The final piece in this project was Sculpture IV. In this last piece I tried to find an image that was more personal, one that did not have a direct reference to another society or another time. I wanted to draw from my own experience in art and produce an object that had a more universal symbolism. I feel that the influences in this work were so varied and mixed that no one single influence can be determined. Also another driving force in this work was the desire to create an object that fully utilized the techniques of blacksmithing. In Sculpture I and II the solid forms had a tendency to dominate the work and so any enclosed shapes were deleted from the design of Sculpture III. Yet I felt that this last work should include some solid forms. I created these forms from pipe and enclosed them with sheet steel. I felt that this use of form had evolved from the enclosed form as the dominant shape to the enclosed form becoming the subordinate shape. This was my way of visually demonstrating the dominance of blacksmithing techniques over construction techniques.

The blacksmithing in this last piece is most successful. The forms that are created evolved from the techniques themselves. The forms could not have been reproduced as quickly or as successfully by any other method of working. The only method that would come close to duplicating these shapes is casting and casting is a much longer, more complicated process. This sculpture, I believe, is the best of the series. It not

only uses the techniques of blacksmithing better than the other pieces but produces an image that has all the characteristics most representative of forged steel. The steel appears strong and massive, yet it sensitively holds the circles. It reaches out in slow delicately hesitating tendrils. It holds an image in the circles that is a powerful symbol with a hundred references to the past, yet the symbolism is new in the fact that it has never been seen before. This work holds all the contradictions of steel construction and blacksmithing techniques: the combination of ancient techniques of blacksmithing with the relatively new welding techniques; the manipulation of a material that cannot normally be altered yet is drastically changed in the forge; and the physical contradictions that are the heat of the forge that allowed the change in the steel and the cold of the water that quenched and returned the steel to its unyielding strength.

This project has proved to be most successful. I have gone from blacksmithed forms as enhancements of a constructed sculpture to blacksmithed steel as the form itself. The techniques have proved not only to be quicker than any other method I know but unique inasmuch as they cannot be easily duplicated by any other means of working metal. For the individual artist working in steel, I highly recommend this method. Though the work may appear strenous, it is worth the extra effort.

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